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ABSTRACT

This guide to environmental and outdoor education is based on the principle that man will properly care for his world only if he both understands and appreciates it. Seventy-two multidisciplinary environmental themes are identified for instruction in grades K-12. Each theme is presented with behavioral objectives, key concepts, and both in school and out of school activities. The outdoor activities are heavily emphasized, and designed for a local nature center, public parts, and campgrounds. Disciplines incorporated together and separately in the themes are: science, social studies, math, and humanities. The guide recommends that the themes be taught in conjunction with the regular curricula, when appropriate. Supplementing each theme group (K-3, 4-6, and 7-12) are extensive resource guides to films, recordings, filmstrips, pamphlets, and books. A final section presents ideas and information for teachers in planning outdoor experiences, such as: literature and music for the outdoors, and how to read a compass. (DJB)

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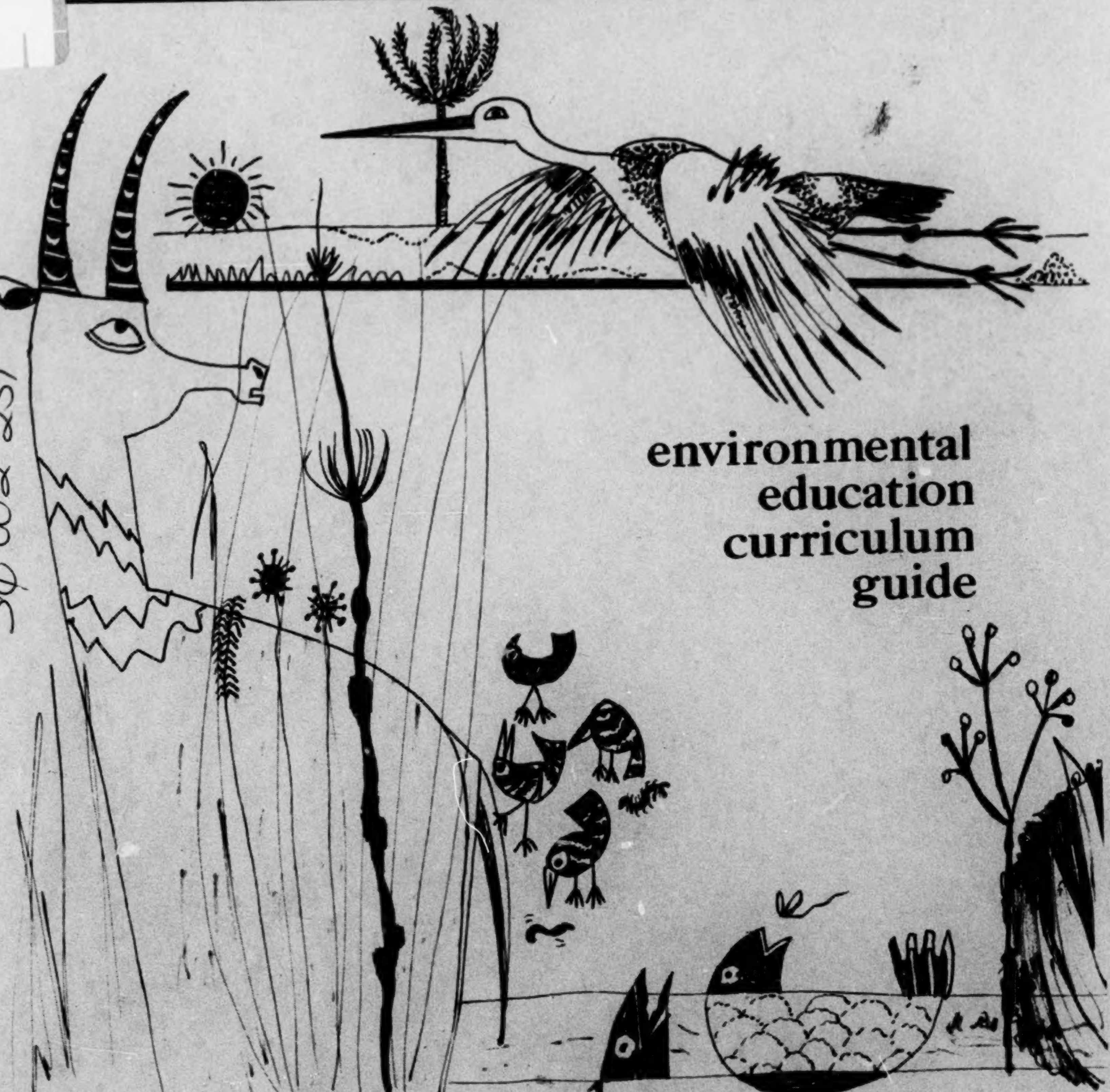
# title III ESEA project
# NORTHERN COLORADO OUTDOOR NATURE CENTER



## environmental education curriculum guide

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# K-12 CURRICULUM GUIDE
# FOR
# ENVIRONMENTAL EDUCATION

## NORTHERN COLORADO OUTDOOR NATURE CENTER

Poudre School District R-1
Colorado State University
Fort Collins, Colorado

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## ACKNOWLEDGEMENT

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# FOREWORD

To Teacher Guide - Poudre School District R-1

--Charles Holtzer

Many of us are familiar with the famous quote: "We have met the enemy and they are ours." This quote has been modified somewhat as of late by a contemporary famous character with the name of Pogo, who said: "We have met the enemy and they is us."

It has been said that man is the only animal which befouls its own nest. It appears to me that before we can get a significant percentage of the population to stop befouling the environment in which we all live, we must first find ways to help people change their present values and attitudes toward their natural and man-made environment. I do not believe we can do the job effectively and have a quality environment by singling out any one type of desecration to which we are subjecting our natural and man-made environment. We can no more motivate most people to stop scenic pollution, for example, than we can motivate them to stop the emphasis upon over-materialism, over-consumption, and over-waste, until they have been inculcated with an awareness and appreciation of the interrelationships and resultant interdependencies which exist between man and his environment. And not until man learns to respect the rights of all people to live in a quality environment.

And not until people become cognizant of the fact that so long as we insist upon the "good life" and an increasingly higher standard of living for the middle classes and above, which involves among other things a no-deposit, no-return, throw-away society, will we ever cease inflicting insults upon our natural and man-made environment and prevent suffocating ourselves in our own wastes!

One of the major goals of education is to help prepare children for their responsibilities in an adult society and to help them adapt to that society as comfortably as possible. In order to achieve the above, educators place a great deal of importance upon the ability of each child to communicate properly through development of skills in reading, writing, and speaking. It is also considered important that the pupil understands and can manipulate mathematical figures. He must have a reasonable knowledge of scientific achievements in order to understand more fully the technological society in which we live. And, of course, how can one adapt adequately to his society unless he has a knowledge of its history, its politics, its geography and economy? Physical education and the development of recreational skills are considered essential, for we must have a reasonably physically and mentally healthy citizenry. And, finally, to round out a child culturally, he must be exposed to good literature, art, and music.

But education has for the most part neglected to help children understand, appreciate, and assume responsibility for the natural and man-made environment into which they will need to adapt as adults. How then can we expect these future adults to be concerned for not only the lakes, the forests, the streams, the rivers, the valleys, the meadows, the mountains and the wildlife which make up our natural environment, but the air, water, noise, and scenic pollution of our man-made environment? How can we ever hope to change our value system and those of our children which, by its very nature, causes negative influences upon our environment; a value system which is primarily based upon, as Chancellor Maurice B. Mitchell of the University of Denver, put it, "How much?", "How big?" and "What will it do for us economically?" And not upon: "What will it do to our psyches and to our human spirit?" "Is this material thing we think we need and want worth what we may have to sacrifice in order to obtain it?"

It is my firm conviction that we are in the middle of an environmental crisis largely because education in our public and private schools and in our colleges and universities never attempted to help our adult citizens of today to develop an understanding and appreciation of man's place in the natural world. Education never attempted to show us how to live in harmony with our environment, as Aldo Leopold, a well-known conservationist, so beautifully put it.

Unless our nation's schools begin to consider environmental education at least as important as other disciplines in rounding out a child's education . . . then the day may very well come when we will no longer have much need for our "readin', writin' n' 'rithmetic," simply because there will be little use for these skills in a dying society. All our efforts may very well need to be directed to simply trying to physically and emotionally survive in a man-made hostile environment.

Education, I believe, cannot educate all or even most children to respect their environment without helping to mold in young people values and attitudes different from those with which our present adult society has grown up. We cannot concentrate all of our efforts in merely cleaning up the environment, which is what we seem to be attempting to do now, without at the same time helping the next generation develop values and attitudes which will help assure a quality environment for all time--values and attitudes which place less importance upon materialism, but which emphasize self-worth, a respect for oneself and others, respect for our environment and a desire for a quality of living we do not now seem to have. We need an educational program in which the philosophy of conservation . . . man living in harmony with his environment . . . is not treated as one chapter in the very last pages of a social studies or science textbook, but rather, permeates the entire school curriculum! Living in harmony with one's environment can, indeed, must become a part of every course in language arts, political science, sociology, history, anthropology, psychology, science, economics, fine arts, health, recreation and so on.

If we are ever to halt the deterioration of our environment and heal her wounds as best we can, then educators must: . . . not underestimate "youth power" and encourage young people to influence the attitudes of their own parents regarding environmental problems. (Even a small child can have impact upon his parents by such simple admonitions as, "Daddy, don't throw that empty cigarette pack on the street. Teacher says it's bad to be a litter-bug.") . . . give junior and senior high school students who are about to enter and make their impact upon the adult world, an understanding of environmental problems and of what they as citizens can do to solve these problems.

Even if we find solutions to halt deterioration of our environment, the complete problem has not been solved. Another generation will be growing up. If we fail to instill an understanding and appreciation for the physical environment in these youngsters, starting in the earliest grades and sequentially through high school, then these young people will undoubtedly grow up with the same value system and the same attitudes which caused our adult population to create the present environmental crisis.

A comparatively new educational approach to the above problems has been developed and implemented by many school districts throughout the nation. Known as Environmental Education, it consists of three major concepts:

(1) Content Help children to understand and become aware of the relationships of all living things, including man, to their environments and to develop an appreciation of all the ramifications of this concept, particularly when man tips the scales of the "Balance of Nature."

(2) Learning Environment All too often teachers become dispensers of knowledge and the students merely sponges who soak up information. Opportunities for pupils to apply in real life situations knowledge gained in the classroom is usually quite limited in the school because of the physical limitations imposed by the classroom. Instead, the teacher must often create an artificial situation to give children experiences in applying what they have learned. The learning which takes place in this kind of learning environment is bound to be limited. We appear to learn primarily what we live.

Environmental education provides an opportunity for extending the formal classroom into a more informal outdoor learning environment. The purpose of utilizing the outdoors is to complement the school curriculum by continuing the educational processes where "indoor education" leaves off, due to the physical and, in some cases, mental limitations imposed by the desks, chairs, and four walls of a classroom. It is a tenet of environmental education that learning should take place in the kind of physical learning environment which is most conducive to a particular teaching and learning situation. This type of program also provides unlimited opportunities to apply practically, in real life situations, knowledge gained in the classroom as well as unlimited opportunities for development of conceptual thinking through problem-finding, problem-solving and self-discovery experiences.

Verbal and abstract "indoor learning" can come alive through real experiences. The vicarious world of books is enhanced and enriched by the real world of people and things. As contemporary curricula continually appears to lean toward emphasis primarily upon abstract knowledge, the necessity for hanging onto concrete learning becomes more important than ever.

(3) Attitudinal and Behavior Modifications Environmental education provides academic and physical challenges to the "average" and gifted child by complementing the world of books with the real world of people and things and provides unique opportunities for the underachiever to manifest latent abilities which may not reveal themselves in the formal classroom. In addition, such a program offers opportunities for children who lack a feeling of self-worth to begin such development within themselves, through achieving and possibly excelling in some outdoor activity. Through an environmental education program there is offered an unique opportunity for the classroom teacher to observe the "whole" child; the child reacting to learning stimuli in the classroom and the child reacting to learning stimuli in a more informal learning environment.

The Poudre School District, R-1 in Fort Collins, Colorado, recognized the need for giving its young people opportunities to learn about their relationships to the environment in which we all live. The district realized that in order to make such learning truly relevant, classroom learning needs to be complemented by learning through direct experiences in the natural world. Thus, in July, 1968, the Poudre School District applied for funds through Title III, E.S.E.A., to plan for an environmental education program. The proposal was approved on April 1, 1969, and Dr. Howard Bruner, Professor, Education, Colorado State University, was asked to serve as director of the project. Through his abundant and very contagious enthusiasm and great effort, and with the enthusiasm, dedication and efforts of a select group of elementary and secondary teachers from the Poudre Schools, this Teachers' Guide was created. The guide is a culmination of many hours devoted to meetings, field trips and plain, down-to-earth hard work. It is a guide which should be of invaluable help to teachers at all grade levels, K-12, who recognize the urgent need for young people to understand and respect the only environment we have now and in the foreseeable future, and who also recognize the potential of the outdoors as a learning environment and as an integral part of the entire educational process.

Charles Holtzer, Consultant on
Conservation and Outdoor
Education
Colorado Department of Education
April, 1970

## AN INVITATION

The Colorado State University Nature Center is an area of typical riverbottom land along the valley of the Cache la Poudre River near Fort Collins.

Its purpose is to foster, through study, observation, and experimentation, awareness of the forces which contribute to the quality of our environment and greater sensitivity for man's influence on our American landscape.

We cordially invite all who join in this purpose to enjoy the Colorado State University Nature Center.

A map of the center is provided with instructions on how to reach the Center.

## THIS NATURE CENTER IS YOURS TO ENJOY!

Leave nothing behind but your footprints.

Take nothing, so that others may enjoy their visit, too.

This natural environment is a fragile thing. Nesting animals are easily frightened. Plants are easily trampled. Only you can protect them by staying on the trails and not picking flowers.

Please take all litter with you when you leave, and pick up after those who have been careless.

Fire can destroy everything. Please, no matches!

No hunting or running dogs are permitted.

Be sure the gate is locked when you leave.

We would like to know about your visit. Please report anything wrong or make suggestions for improvement by calling the numbers listed hereafter in the section on how to use the nature center.

# HOW TO USE THE NATURE CENTER

This area is being developed by Colorado State University, Poudre R-1 School District, and numerous businessmen and local organizations as a protected environmental study area for students and for all other interested citizens of the region.

It is not a public recreation area. Development is incomplete and several facilities are lacking. Until a bridge is built, visitors cannot cross the river during high water.

Funds are not yet available for maintenance. Therefore, the entrance gate is kept locked to prevent casual use and vandalism.

Visitors may borrow a key in order to drive into the parking lot or they may park at the entrance gate and walk into the area.

Keys may be reserved at the below-listed offices. They must be returned immediately after use.

Buford Plemmons
Poudre R-1 School District
Administrative Offices
2407 LaPorte Avenue
Fort Collins, Colorado
Telephone 482-7420

Howard Bruner
Department of Education
Room 214, Liberal Arts
Colorado State University
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& Watershed Resources
Room 210, Forestry
Colorado State University
Fort Collins, Colorado
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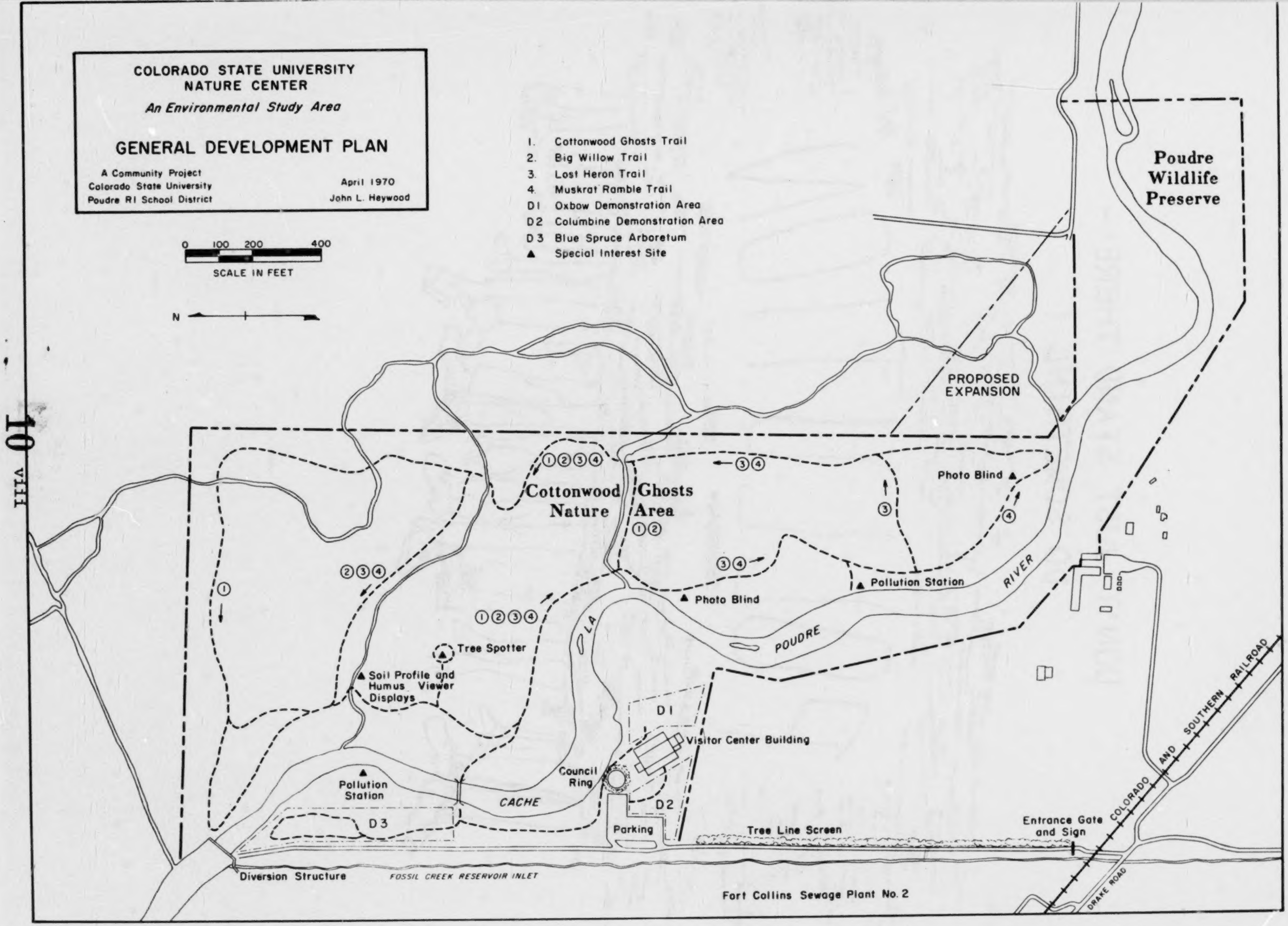


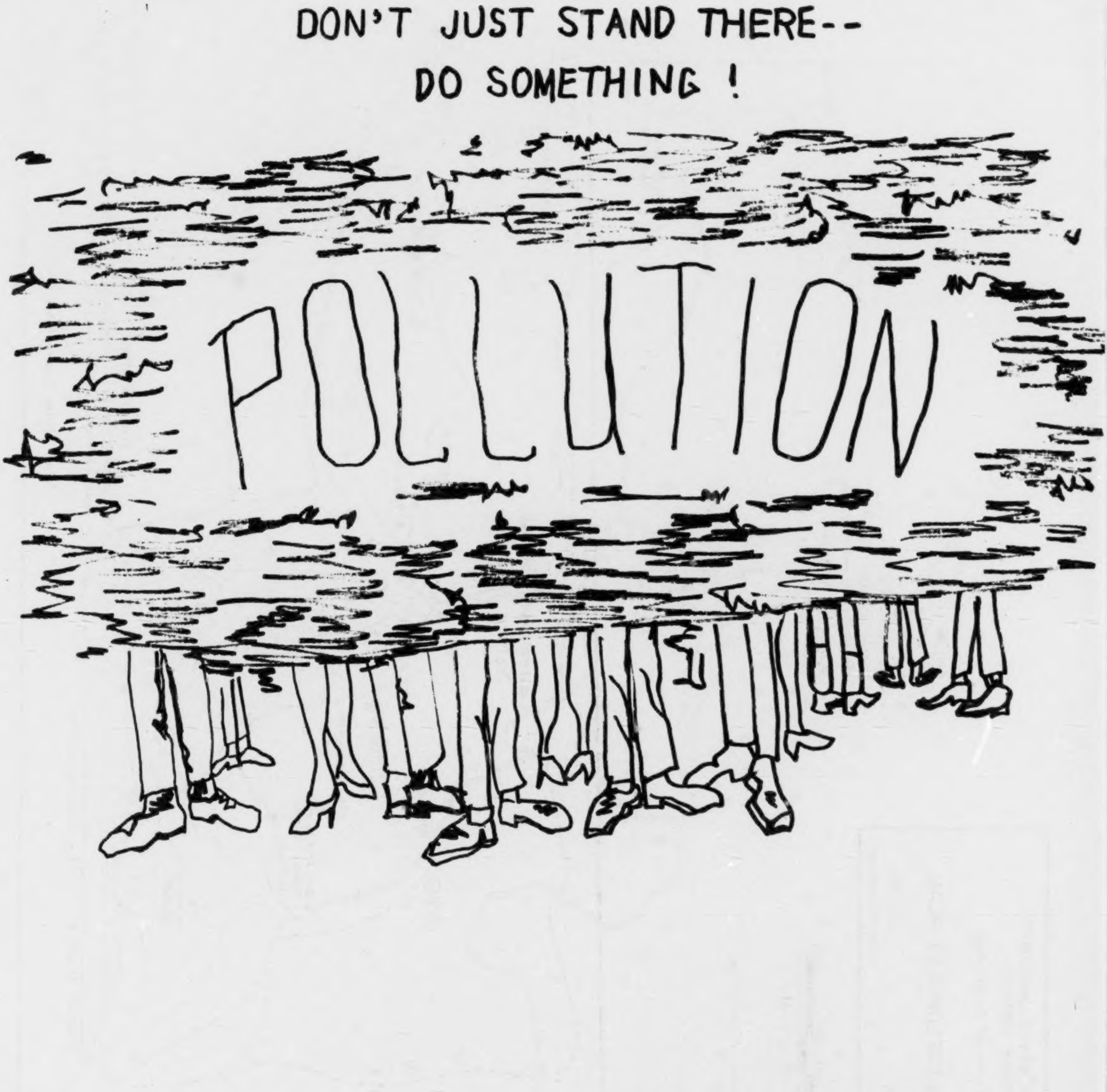
COLORADO STATE UNIVERSITY
NATURE CENTER
*An Environmental Study Area*

GENERAL DEVELOPMENT PLAN

A Community Project
Colorado State University
Poudre RI School District

April 1970
John L. Heywood

1. Cottonwood Ghosts Trail
2. Big Willow Trail
3. Lost Heron Trail
4. Muskrat Ramble Trail
D1 Oxbow Demonstration Area
D2 Columbine Demonstration Area
D3 Blue Spruce Arboretum
▲ Special Interest Site
0 100 200 400
SCALE IN FEET
N
Poudre Wildlife Preserve
PROPOSED EXPANSION
Cottonwood Nature Ghosts Area
①②③④
①②
③④
③
④
②③④
①
①②③④
Photo Blind
Pollution Station
POUDRE RIVER
LA
CACHE
Tree Spotter
Soil Profile and Humus Viewer Displays
Pollution Station
D1
D2
D3
Visitor Center Building
Council Ring
Parking
Tree Line Screen
Entrance Gate and Sign
COLORADO AND SOUTHERN RAILROAD
DRAKE ROAD
Diversion Structure
FOSSIL CREEK RESERVOIR INLET
Fort Collins Sewage Plant No. 2


DON'T JUST STAND THERE--
DO SOMETHING !
POLLUTION

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## INTRODUCTION TO THE CURRICULUM GUIDE

This guide to environmental and outdoor education was prepared by faculty representatives from the Poudre R-1 School District. It was developed after a full year of careful study, examining other successful outdoor education programs, and exploring current available resources.

The philosophy supporting this curriculum guide is centered around the idea that man will properly care for his world only when he properly understands and appreciates it. The value of the guide is to provide a plan for early and continuous experiences in outdoor education. These activities are designed so as to take place in or near the school, at the nature center, or at selected sites some distance from the classroom. The basic idea is for students to have real experiences where the outdoors becomes a classroom.

It is intended that regardless of the level of education or the subject being taught, the teacher may find a theme or two which fit into the yearly plan. Here the teacher has an opportunity to use the outdoors as a laboratory for stressing educational experiences where the environment is the most efficient place.

The first section of the guide is a selection of environmental themes. They are presented in chronological order, starting with experiences for the primary grades and followed by themes for the intermediate grades and for the junior and senior high school. The selected themes do not cover every possible interest or topic--rather, they are representative samples of effective outdoor experiences. The creative teacher may very well add to the list of themes or vary the activities provided in the guide.

The themes are followed by a compiled list of suggested resources. Resources that are available locally are so indicated. Others are listed if new materials can be rented or purchased. Many new instructional resources are being produced in all areas of environmental studies. The teacher should be searching for those appropriate to the subject and grade level being taught and should add them to the resource list.

The final section of the guide is devoted to special interest topics for teachers. These selected articles describe in some detail selected activities that could be carried on in the classroom. The literature in the field provides an abundance of similar ideas for teachers to incorporate in their lesson planning.

A final word: the guide is not prescriptive. It is provided as a springboard for more effective teaching of environmental studies. With the help of dedicated teachers, our future citizens will develop a sound set of values in the care and use of the world's resources.

GRADES K-1-2-3

## SCIENCE THEMES

Theme I: Weather and its changes affect all living things.

Basic Concepts

1. Weather conditions change as the temperature changes.
2. We can see weather changes by observing the sky.
3. Weather affects the behavior of plants and animals.
4. Our kind of work and play depends in part on weather.

Behavioral Objectives

1. The students will name and describe appropriate clothing for various kinds of weather.
2. Students will know what a thermometer is and how to read one.
3. Students will know what makes clouds and how they are different.
4. They should be able to describe the games and sports they take part in when it rains and when it snows.
5. The student will observe the effect of temperature in changing snow to water.

Activities at School

1. Students can make their own weather station at the school. They can make observations about rain, snow, and temperature.

Activities at Center

1. Take students on a tour of the nature trail. They can observe the clouds, observe the effect of recent weather on soil and plant life, make observations at the weather station, and record their observations.
2. Take students on a tour of the nature trail. Let them observe snow-covered mountains from the stream bed.

Theme II: Living things that we see around us change with the four seasons. The behavior of both plants and animals is affected by the four seasons.

Basic Concepts

1. Animals live in many different kinds of homes. Sometimes these homes change because of season changes.
2. Plants behave in different ways because of the seasons.

3. The food supply for all living things is affected by changes in the seasons.
4. Animals and plants change their color and protective cover according to the seasons.
5. The number and kinds of living things that we see change with the four seasons.
6. Man changes his behavior as he is affected by the seasons.

Behavioral Objectives

1. The students will describe orally the four seasons in Colorado and list several characteristics of each.
2. Explain the changes in the plant life of the community as the seasons change.
3. The students will observe and explain orally what happens to the animals during the winter.
4. The student will explain how to dress for the nature trail visit.

Activities at School

1. An excellent and necessary activity that should precede the nature trail tour is a safety exercise. Children should discuss the (a) proper clothing to wear, (b) how to cross the water on the bridge, (c) the danger of toxic plants, (d) the problems of running and throwing rocks, (e) the dangers of the water and the riverbank, and (f) protection from insect bites.
2. Students can prepare a science table or corner in the classroom on which the signs of spring and fall can be displayed. Drawings of students' interpretations of the seasons could be included in the display.

Activities at Center

1. Take students on a tour of the nature trails. It would be most effective if seasonal visits could be planned. Students could discover the animal life present during the different seasons. Changes in plant life could be observed. Homes of the animals can be observed. The students can discover the signs of spring and winter.

Theme III: Students realize that as resource users they must also accept the responsibilities as resource savers. It is important for us to know how to use and care for our natural resources.

Basic Concepts

1. There is a balance of nature in our environment and man can upset that balance.
2. We can truly discover nature by taking full advantage of our senses.
3. Nature is beautiful, and we must develop appreciation for this great gift.
4. Our natural resources will be abundant only as long as we properly care for them.

Behavioral Objectives

1. Be able to describe what is meant by littering and water pollution, and give several common examples observed in the community.
2. The students should be able to identify three odors and three sounds familiar to the site.
3. Be able to express in their own words why they think the outdoors is beautiful.
4. The students will tell how to be a good resource user and practice these suggestions at the center, in the home, and in the community.
5. The students will name three ways that man has upset nature, as observed at the nature center or in the community.

Activities at School

1. Write a paragraph or describe the odors or the sounds of the nature area.
2. Collect pictures from magazines and newspapers that show man upsetting nature. Prepare a bulletin board with the illustrations.
3. Draw a picture or illustration about one thing observed at the nature center that is considered beautiful.
4. Observe and report to the class good and bad practices at home and in the neighborhood in relationship to resource users.

Activities at Center

1. Tour part of the trails in complete silence (10 minutes); then have the students tell others what they observed (through sight, hearing, touch).

heme IV: In many ways animals are the same, and in many ways they are different. These differences help animals live in a certain community.

Basic Concepts

1. Many different animals live successfully together in the same area.
2. An animal's body is adapted for the place where he lives. The food he eats and his protection is provided by this adaptation.
3. Man upsets the balance of nature and disturbs the life habits of animals and plants.

Behavioral Objectives

1. The student will know three animals that live near the water and will be able to name the food (plant and animal) it uses.
2. The student will know three animals of the prairie community and the animals and plants they use for food.
3. Give one example where man upsets the balance of nature and be able to explain how this affected the plants and animals in the area.
4. The student will know the name of one animal that is protected by its color and will be able to describe how he is protected.

Activities at School

1. Build and develop an aquarium or terrarium. The planning of the project and its continuous care is of utmost importance.
2. The class collects and displays plant life, insects, etc., that are representative of the geographic region.
3. Mock-up displays in the classroom, using mounted animals, can show the natural colorations and illustrate their protective power.
4. Let the students collect pictures of animals that illustrate natural coloration as a protective factor. These can be displayed on the bulletin board.

Activities at Center

1. Students collect and study the insect life in a specific community. The nature center provides excellent ecological communities close to the riverbank and the prairie community further away from the river. The micro-bio gun and the magnascope vial is an easy and effective way to involve an entire class in a study at the center.

Theme V: Plants of any community are dependent on their environment (animals, soil, other plants) to meet their daily needs.

Basic Concepts

1. Plants growing together form communities. Each member of the community influences the other.
2. There are many different kinds of plants. Each kind of flowering plant has its own type of root, stem, branches, and leaves. These special characteristics assist the plant in adapting to a particular environment.
3. There is a very close relationship between plants, animals, and the soil. Each helps the other in several ways.

Behavioral Objectives

1. The student will be able to take a flowering plant and identify the six basic parts of the plant and their functions.
2. The student will be able to describe examples of interdependence between animals, plants, and soil.
3. The student will be able to identify several plants and animals common to the nature center and tell why each is able to live in the area.

Activities at School

1. After touring the nature trails, plan a guess-who game where the student gives clues of an animal or plant and the other students try to identify it.
2. Students can prepare dioramas, bulletin board displays, or exhibits depicting the plant and animal life representative of the region.

Activities at Center

1. Tour one of the nature trails and have students discover and identify as many different kinds of plants or animals as they are able to. They might also suggest why they live in such a setting.

Theme VI: Soil is made up of rock and decaying organic material. Soil helps provide our food; consequently, we must learn to use the soil wisely.

Basic Concepts

1. Soil consists of crumbled or worn-down rock. Minerals in the rock are transferred to the soil.
2. Plants and animals that die and decay make up the humus in the soil. Growing plants need humus.

3. Plants use minerals in the soil and these need to be replenished.
4. Water can help us build soil but also can be destructive.
5. Man needs good soil to grow crops.

Behavioral Objectives

1. The student will be able to distinguish between clay and sand.
2. The student will know what substances make up soil.
3. The student will know two ways that plant and animal life is decomposed and made into soil.
4. The student will be able to describe results of erosion.

Activities at School

1. Student may examine soil in the classroom and discover the rock and organic material in it. Samples of pure silicone sand and clay can also be observed. Some kind of magnifying device will make this experience more exciting.
2. A small plot of grass could be plotted near the school and its ability to hold this soil could be discovered.
3. A simple demonstration showing the soil-holding power of plants could be prepared for the class at school.

Activities at Center

1. Students can visit the nature area after a rain or snow. Students can observe effects of rain on bare soil and covered soil. They can see the erosion on the banks of the river. Soil can also be examined for kinds of organic material. Rocks and their shapes can be observed; insects can also be seen at work on rotting logs.

## NON-SCIENCE THEMES

Theme VII: Outdoor experiences in art appreciation.

Basic Concepts

1. Animals use many kinds of materials found in their environment to build their homes.
2. Children discover art in nature through line, color, design, texture, and harmony of the outdoors.
3. Children develop the value of their senses through the use of their senses in the outdoors.

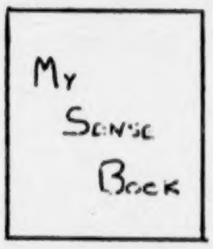
Behavioral Objectives

1. The students will develop the value of their senses through the use of their senses (touch, sight, hearing, feeling, taste).
2. The student will develop an understanding of the limitation of the taste sense in the outdoors.
3. The student will learn to discover art in nature through line, color, design, texture, and harmony of the outdoors.
4. The student will learn ways to preserve nature.
5. Children will develop the understanding that birds and other animals use many kinds of materials found in their environments to build their homes.

Activities at School

1. Each student can prepare a sense booklet to take to the outdoor nature center, such as:

   Cover:



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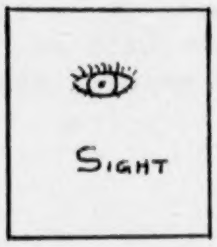

   Each student can make illustrations in his booklet, showing his discoveries in the outdoors.
2. It would be necessary to have a safety lesson on the tasting sense before going to the outdoor nature center.
3. Have children collect objects such as sticks, twigs, bits of paper, string, moss, grass, etc., and bring to the class to construct bird nests.
4. Before taking the class on a nature tour, have litterbags made by the children to take with them. They can decorate a brown paper bag.

Activities at Center

1. Take time for a sensory hike--let the students walk without talking, then stop and listen. Let the students tell what they hear --a mosquito's hum, a falling leaf.
2. The children can draw pictures at the nature center, showing lines, colors, designs, textures, and harmony in nature.
3. Children can visit the center each season and illustrate a particular scene, tree, etc., showing seasonal changes.

Theme VIII: Develop the understanding of the child's place and responsibilities in outdoor citizenship at home and in the community.

Basic Concepts
1. The family needs to conserve the beauty of America's outdoors during their outings.
2. One needs to be respectful of other people's feelings and property.

Behavioral Objectives
1. The child needs to develop in himself and in his family the need to conserve the beauty of America's outdoors during their family activities in the yard or on trips away from home.
2. The child needs to develop respect for people and property; this needs to be in connection with both school and community.
3. The child needs to become aware of his role in the conservation of natural resources.

Activities at School
1. Have the child find pictures in magazines of families doing things together outdoors.
2. Have the class compile a list of things to do on outings, such as items to take on picnics, games to play, and things to help us have a safe and happy trip. Give each child a copy to take home.
3. Through dramatic play, have children act out irresponsible behavior and then responsible behavior, such as littering, putting out camp fires, or picking wild flowers.
4. Have the children construct a mural (flannel board, painted scene, or paper cutouts) to illustrate what a beautiful forest is like or how to have a picnic in the park.
5. Have the student survey his home and yard, and report instances of litter and pollution. He could do the same in observations on the way to and from school.

Theme IX: The stimulation and development of language in the outdoors.

Basic Concepts
1. New words are understood when they are used.
2. Communication skills are improved when applied to experience.

Behavioral Objectives
1. Students will develop a growing vocabulary and verbal intelligence.
2. The children will develop the idea of labeling things in their environment, i.e., "That's a duck."
3. The children will begin to use correct verb forms and tenses.

Activities at School
1. The children can write a story, using words concerning the site.
2. The children and teacher can make an experience chart after the visit.
3. The children can tell what they saw and practice using correct verb forms, i.e., "I saw a bird." "I had never seen one like that before the trip."
4. After making a booklet or picture (either on site or in the classroom), each child can tell about his picture or booklet of things they saw.

Activities at Center
1. The children can visit the nature center and the teacher and child can label things they see.

Theme X: Music can help us express our feelings about the wonders of the outdoors.

Basic Concepts
1. Esthetics in music is related to appreciation of the outdoors.
2. Songs tell us how to appreciate and take care of nature.

Behavioral Objectives
1. Students will sing songs about nature that they select.
2. Students will appreciate nature by observing rhythm and musical sounds.
3. Express enjoyment of nature by singing about its gifts.

Activities at School

1. Student might make up lyrics for a song after he returns from a visit to the nature center.

Activities at Center

1. Songs about nature can be sung by students prior to visiting the center or while students are en route to and from the center while on the bus. A tape recorder could be used for musical accompaniment, if necessary.

Teachers' Note:

1. No effort was made to specify the grade level for each activity. Ultimately, the activities will be organized into the total science curriculum.
2. It should be kept in mind that these activities represent the kind that can be carried out at or near the school, as well as at the nature center.
3. It is important to remember that new terms need to be introduced to the children, some of which are: conservation, natural resources, deciduous, coniferous, seasons, habitat, senses, migration, insects, hibernate, humus, erosion, terrarium, prairie, soil, aquarium, community, environment, responsibility, citizen, design, behavior, irresponsible, responsible, texture, harmony, litter, pollution.
4. The teacher should keep in mind that the themes and activities are only suggestions. Special interests and special abilities of students should be used in detailed planning.

GRADES 4-5-6

## SCIENCE THEMES

Theme I: All living things depend upon green plants for food.

Basic Concepts

1. Green plants contain chlorophyll and produce oxygen and carbon dioxide in connection with photosynthesis.
2. Each part of the plant performs a specific function.
3. Food is stored in different parts of the plant for its own propagation.
4. Plants and animals depend upon each other for existence; this is called the "food chain."
5. Man depends upon stored food in plants.

Behavioral Objectives

1. The student will name the parts of a plant and explain the function of each part.
2. The student will test food for starch, oil, and acid. (Check teachers' notes.)
3. The student will list the essential materials in photosynthesis.
4. The student will list the ways in which green plants support other forms of life.

Activities at School

1. The student will secure a plant at home or near the school and will locate the root, stem, leaf, flower, and seed structures.
2. The student will draw a picture of a green plant and label the basic parts on the drawing.
3. An appropriate activity might be for the student to chart a food chain through several steps to illustrate the interdependence between animals and green plants.
4. An experiment showing the importance of sunlight can be carried out in the classroom by planting seeds under controlled lighting.
5. Illustrate the oxygen-carbon dioxide cycle performed in plants.

Activities at Center

1. A field trip to the nature area could be accompanied by discovering examples of edible plants and toxic plants.
2. Students could also observe evidences of stored food in plants.
3. It would also be important for the student to contrast the plant community of the prairie with the plant community of the "cottonwood basin."

Teachers' Note:

1. The test for oil is made by rubbing the plant against a brown paper bag. If the plant contains oil, the paper will become translucent. For the acid test, use litmus paper. To conduct a test for starch, the key is that iodine turns starches blue.

Theme II: It is important for man to know that plants are classified according to their unique functions.

Basic Concepts

1. Plants can be grouped as green and non-green.
2. Non-green plants do not contain chlorophyll and obtain food from green plants or decaying green plants.
3. Some green and non-green plants are food for man, others are poisonous.

Behavioral Objectives

1. The student will name four types of non-green plants.
2. The student will describe the environment necessary for non-green plants to grow.
3. The student will list two ways that non-green plants are beneficial to man and two ways that they are harmful to man.
4. The student will compare a green and non-green plant and will list their differences.

Activities at School

1. Collect or photograph non-green plants.
2. Prepare a report on the environment where the plants are found.
3. Display pictures or plants in the classroom.
4. Take a mushroom hike after a rain in the early fall. Look for some of the common characteristics and report on what you discover. Emphasis on non-edible mushrooms would be most profitable, i.e., never eat a gilled mushroom! Also, if you find an inky-cap mushroom, the student can write with the ink.
5. Grow some citrus molds by inoculation. Take blue mold from a lemon or an orange and place it on a healthy citrus fruit. Cut the citrus fruit through the rind.
6. Find out how much of a mushroom is water (by letting it dehydrate in a sealed jar).

Activities at Center

1. A field trip to the nature area could be taken. Non-green plants could be photographed or drawings could be made for later discussion and study.
2. Discover conditions needed for non-green plants to grow.
3. Find examples of poisonous plants.

Theme III: If man upsets the balance of nature, it will affect his very existence.

Basic Concepts

1. Pollution of the environment (air, soil, water) destroys those elements essential to the life of man and those things upon which he is dependent.
2. Care of our outdoors is important to preserve natural beauty in the world.
3. If man upsets the balance of nature, plant and animal communities are altered and sometimes destroyed.
4. Changing or controlling the flow of water above or below the ground can disrupt nature.

Behavioral Objectives

1. The student will list several examples of man upsetting the balance of nature. (The nature area or any other designated area in the community could be the subject for the list to be prepared.)
2. Describe three ways that man pollutes the air, water, and soil.
3. Provide a description of one method man might use to reduce pollution.

Activities at School

1. Write a poem about man's destruction or poor care of his outdoors.
2. A resource person might talk to the class on pollution problems in the regional community. (A soil conservation agent would be most effective.) Such an activity might be planned prior to a nature center visit.
3. A good follow-up study is a discussion on some phase of pollution and how it can be controlled. These can be most effective if related to the local community.

4. Pictures from magazines can be selected and bulletin board displays made on pollution problems.

Activities at Center

1. Make a tour of the nature center. Divide the class into small groups (3-4) and have each prepare a list of examples of man's upsetting nature. Pictures might be taken for display purposes.
2. List ways that man has polluted the center, i.e., trails, council ring, etc.

Teachers' Note:

1. Check social studies theme which is excellent on pollution.

Theme IV: Weather changes during the seasons cause changes in the behavior of plant and animal life.

Basic Concepts

1. Weather affects growth and development of plant life.
2. The availability of food affects the number of animals in the area.
3. Some plants and animals do not survive the winter. Some plants may be dormant while animals may hibernate or migrate.

Behavioral Objectives

1. Student will name several animals that stay in the nature center during the winter.
2. The student will describe the adaptive characteristics of each animal to winter weather.
3. The student will understand the basic concepts of reading a weather map.
4. The student will know the fundamentals in weather forecasting and how to read a thermometer and barometer.
5. The student will describe what makes rain, snow, and hail.

Activities at School

1. Read weather instruments.
2. Make predictions on the coming weather. A record of observations over a number of days would be very appropriate.

3. The students could plan and make their own weather station. A record of temperatures, rainfall, wind velocity, and other significant weather information could be recorded.
4. Weather predictions could be made for the school newspaper.
5. Write a poem describing winter and its effect on plants and animals in the area.
6. Explain the effects of early snow on plant life. What happened to trees, apples, flowers, beets? What caused this early snow?

Activities at Center
1. A trip to the outdoor center could be taken in the winter and again in late spring or early fall. Animal and plant life could be observed.
2. A count of animals could be made that remain during the winter months.
3. Plants that remain active during the winter could also be observed and recorded.
4. Students could discover evidences of unseen animals and observe their winter homes.
5. Observations could also be made regarding the availability of foods.

Theme V: It is important to know how animals are classified for identification and study.

Basic Concepts
1. Animals are grouped according to comparative structures.
2. Animals are classified as vertebrates and invertebrates.

Behavioral Objectives
1. The student will name the five classes of vertebrates and give an example of each.
2. The student will be able to name the classes of invertebrates and give an example of each.

Activities at School
1. Prepare charts to classify animals into classes, to be used at the center.
2. A follow-up study could be made by students regarding specific animals found at the nature center. A description of their adaptations for a specific community could be prepared.

3. Drawings of animal life found at the nature center could be shown as representative of the classes of animal life.

Theme VIa: Growth[1] and development of organisms through the study of life cycles.

Basic Concepts

1. The student identifies the life cycle of plants through the seasons.

Behavioral Objectives

1. The students will name and locate the parts of a plan
2. The students will explain why plants need food, water, air, and light.
3. The students will know how plants provide for reproduction and will be able to gather evidence to explain.
4. The students will explain how plants help in the formation of soil.
5. The students will explain the make-up of a soil sample.
6. The students will list several ways to prevent erosion and increase land capability.

Activities at School

1. Dissect plant (student involvement).
2. Plant seed in light and dark areas; in wet and dry soil.
3. Experiment with sand, clay, and loam soil for water retention power and its effect on decay.
4. Prepare experiment-demonstration on the oxygen cycle.
5. Show how caterpillar uses plants to weave cocoon.
6. Explain migration through examples such as birds, flyways, etc.
7. Prepare experiment showing the effect of erosion on soil and the part that vegetation plays in the problem.

Activities at Center

1. Select plants observed and identify parts.
2. Observe plants near the river, on the prairie, in shaded areas, and in sunlight. Prepare a quadrant to chart plant life.
3. Observe soil properties and decaying process in various locations at the center.
4. Observe migratory animals at the center. Observe parasitic plants and their parts in life cycles.

5. Observe erosion at the center and explore man's efforts to control water and erosion (diversion dam, irrigation ditch).

Theme VIb:

Basic Concepts

1. Student understands the life cycle of the frog as a variation of animals' growth and development.
2. Seasonal changes are closely related to life cycle adaptations by animals.

Behavioral Objectives

1. A student will name and describe the distinct changes in the life cycle of a frog.
2. The student will describe the habitats of the frog.
3. The student will know how the frog adapts to seasonal changes.

Activities at School

1. Draw or make a model showing the frog life cycle--make research investigation of different types of frogs.
2. Study through experimentation food habits of frogs.
3. Dissect a frog.
4. Compare the frog's internal makeup to that of a human being.
5. Observe larvae collected from the center.

Activities at Center

1. Examples of the frog life cycle can be observed. Different types of frogs can also be observed. Pictures could be taken for the record.
2. Observe evidences of frogs during different seasons, i.e., burrow in mud. Tape sounds of frogs.
3. Collect frog larvae from the west side of the drainage ditch.

Theme VIc:

Basic Concepts

1. Understanding the life cycle of insects provides a variation of animal growth and development.

2. Insight into the life cycle of insects provides clues for man's control of insect life.

Behavioral Objectives

1. Students will discover the physical environmental differences of insects.
2. Students will know those structural characteristics of insects that help in the adaptability to the environment.
3. Students will tell how insects live and work together.
4. The student will distinguish between beneficial and harmful insects.
5. The student will describe methods for control of specific insects, i.e., fly, mosquito.

Activities at School

1. Build and sustain an ant farm.
2. Observe length of life of several insects.
3. Investigate and study animals that use insects for food.
4. Investigate differences between beneficial and harmful insects.
5. Find out ways man controls insects (research person).

Activities at Center

1. Catch insects at the center. The micro-gun could be used by an entire class for catching and observing.
2. Observe breeding and nesting places and study the larvae.
3. Observe how insects catch food.
4. Observe animals that eat insects.
5. Find and observe harmful insects compared to beneficial insects.

Theme VII: Microscopic life in our environment influences other plant and animal life.

Basic Concepts

1. Microscopic life affects the life of both plants and animals. Some are harmful; others are beneficial.
2. Man attempts to control microscopic life in an effort to control his very existence.

Behavioral Objectives

1. The student will know the names of several microscopic plants and also several microscopic animals.
2. The student will know the benefits of micro-organisms and the harmful effects.
3. The student will list and describe ways that streams are polluted.

Activities at School

1. The student will learn the care and operation of a microscope.
2. The student will grow yeast, mold, or other microscopic organisms.
3. The student will observe and study corn smut.
4. The student will study stream pollution and chlorine and fluorine.
5. The student will study pond or stagnant water and will prepare a slide for viewing.

Activities at Center

1. Observe stagnant water. (Samples might be brought into the classroom for further study).
2. Tour the sewage plant and get first-hand procedures for water purification.
3. Observe and study fungus and other organisms growing on trees and rocks.

## Theme VIII: Life depends upon water.

Basic Concepts

1. Water is made available to living things by a cycle of evaporation, condensation, and distribution.
2. Wise use of our water resources tends to assure its availability.
3. All living things need water to live.

Behavioral Objectives

1. The student will know the steps in the water cycle and explain each step.
2. The student will explain how water changes from gas to liquid to a solid state.
3. The student will name uses of water by man.
4. The student will be able to explain how man pollutes water.
5. Name two diseases man can get from drinking unsanitary water.
6. The student will describe how water acts as an erosion agent.

Activities at School

1. Demonstrate evaporation--fill jar with water and measure daily.
2. Get report from city utilities on water use in the city.
3. Investigate and report on use of water in the community, i.e., industrial, farming, etc.
4. Report on irrigation activities in the area (resource person).
5. Investigate water reservoirs in the mountains near Fort Collins.
6. Write a story or poem on the life history of a snowflake in the mountains.

Activities at Center

1. Observe the flow of water in the Poudre River at different seasons.
2. Look for effects of freezing and thawing on rocks near the river.
3. Report on the sewage disposal process near the center.
4. Make a list of debris along the banks of the river.

## Theme IX: The wind is both harmful and beneficial.

Basic Concepts

1. The wind is an agent in the constant change in the earth's surface.
2. Proper care of the soil by man will reduce the harmful effects of wind.
3. Plants and animals are adapted to wind.
4. Wind carries seeds to new locales.

Behavioral Objectives

1. The student will explain harmful and beneficial effects of wind. (Examples of each will be pointed out at the nature center.)
2. The student will explain practices by man that control soil erosion. (Examples will be identified in the greater Fort Collins community.)

Activities at School

1. Make reports on different kinds of wind storms, i.e., tornado, cyclone, etc.
2. Have study made of Dust Bowl in the 1930's. A local farmer might talk to the class.
3. Field trip to wind tunnel at CSU.
4. Investigate wind pollination.

Activities at Center

1. At the center students could (a) determine wind speed, (b) observe wind damage to trees and plants, (c) observe odors, (d) observe seed dispersal, (e) observe leaves and branches in the fall of the year.

Theme X: Animals exhibit many different behaviors.

Basic Concepts

1. It is important to know the food-gathering habits of animal life.
2. Animals build their homes according to need, determined by their makeup and environment.
3. Animals have unique ways of communicating to one another.
4. Courting and mating habits and caring for young are important to specie survival.
5. Locomotion characteristics of animals are related to food-gathering habits and protection.

Behavioral Objectives

1. Students will explain how several animals native to Colorado gather and store food.
2. The student will describe ways that animals behave that contribute to preservation.
3. The student will know why and how animals communicate and orally present examples.

Activities at School

1. Make bulletin board of pictures from magazines **that** point out important animal behaviors.
2. Slides and filmstrips could be shown to students on animal life to be observed at the center.
3. After visiting the center, students could investigate and report on animal behaviors observed.

4. Compare and contrast one of the behaviors, i.e., eating habits, of two or more animals.
5. Contrasting spider webs would be interesting, i.e., shape, size, location.

Activities at Center

1. Make observations of animal life and the behavior of animals as viewed at the nature center. (Mammals, birds, amphibians, and insects would be available groups for such activity.)
2. Take photographs of animal life and the behavior of animals as viewed at the nature center.
3. Make drawings of animal life and the behavior of animals as viewed at the nature center.
4. Record animal sounds.

Theme XI: Changing environment affects animal behavior.

Basic Concepts

1. It is important to know how the seasons influence animal behavior.
2. It is important to know how the altitude influences animal behavior.
3. It is important to know how weather (rain, snow, wind, temperature, etc.) influences animal behavior.
4. The availability of food influences the behavior of animals.
5. Animals behave differently in the presence of man.

Behavioral Objectives

1. The student will measure and record the temperature of soil and water.
2. The student will know how to analyze pond and river water for plant and animal life and minerals.
3. The student will list examples of how man invades the environment of animals.
4. The student will know what a food-chain is and will describe a specific example.

Activities at School

1. Measurement of temperatures could be made at the school.
2. Make a terrarium, demonstrating interrelationships of plant life, micro-organisms, and soil.

3. Observe a cricket in light, dark, hot, cold surroundings.

Activities at Center
1. Measure and record soil, air, and water temperatures during the various seasons.
2. Observe animal and plant life in pond water and river water, making contrasts and comparisons.
3. Make comparison of animal life at the "cottonwood" riverbottom during two different seasons.
4. List signs how man has changed environment.
5. Inventory animal life in different communities during different seasons.

## Theme XII: Animal behavior is influenced by their anatomy.

Basic Concepts
1. Animals have different skeletal structures and skin coverings, each playing an important role in the animal's behavior.
2. Sense organs influence animals' behavior in their environment.
3. Organs of locomotion influence animal behavior.

Behavioral Objectives
1. The student will identify the locomotion organs of animal(s) observed.
2. The student will locate the sense organs of animals observed.
3. The student will identify the dominant sense organ of each of several animals.

Activities at School
1. Draw insect, amphibian, and mammal.
2. Label sense organs, locomotion organs, and other distinguishing organs.
3. Make a list of advantages of exoskeletal and endoskeletal animals.

Activities at Center
1. Observe animals that are representative of the several different communities represented at the center, i.e., water, bottomland, prairie. Observe how each is adapted to a special environment.

2. Charades--example: imitate locomotion, hop, crawl, slither, inch, climb.
3. Find animal tracks.
4. Find evidences of feces.
5. Make Plaster of Paris casts of tracks.

## NON-SCIENCE THEMES

### Theme XIII: Man and his mess--pollution. (Social Studies)

Basic Concepts
1. Man's gift of nature, when destroyed, can never be provided a second time.
2. Man's improper ways of taking care of waste destroys life and beauty.
3. More people mean more waste.
4. Waste has many forms--food, water, air.

Behavioral Objectives
1. Pupils will be able to name man's major waste problems.
2. Pupils will be able to formulate methods of waste disposal.
3. Pupils will be able to list beneficial and harmful results of waste disposal.

Activities at School
1. Introduction: Collect waste from classroom for one week. At time of beginning of class, dump it out all over the classroom (surprise to students). "Who will clean it up?" The old "I didn't do it," will not do much toward keeping areas clean. Discuss: city dumps; waste--Where does waste food, water, and air go? Discuss foreign particles in the air--where do they come from? Study how to take air samples (obtain screen from air pollution station). Study how to take soil samples and water samples. Divide the class into three groups for study of air, soil, and water.
2. Analyze samples, as far as possible (a microscopic study of air, water).
3. Bulletin boards on pollution.
4. Use slates for a week to see difference in amount of trash collected in a week.

Activities at Center

1. Have group use filter screen and take air sample.
2. Have group take soil sample.
3. Have group take water sample.
4. Have entire group observe and discuss: toilet facilities, dam, bridge, gravel pit, sewer plant, floods.
5. Students will practice good waste disposal practices.
6. Take sack lunches to the nature center, eat lunch, and observe clean-up activities. Critique students' care of the outdoors.

Theme XIV: Every habitable area contains certain characteristics which man looks for in seeking a place to settle. (Social Studies)

Basic Concepts

1. Different groups of men settled along the foothills of the eastern slope of Colorado.
2. Different homesites and communities have different characteristics.
3. The contributions of racial groups are important in the development of a community.
4. Communities are shaped by the contributions of ethnic and political groups.
5. The rivers in Colorado play an important part in the exploration and development of an area.
6. Different animals choose to inhabit different areas.

Behavioral Objectives

1. The students will list and/or describe reasons for the development of northern Colorado.
2. The students will list at least one early influential person and his contribution to this area from at least all of the following areas: French, German, Spanish, English, Indian, Mexican (see Bill Lopez).
3. The students will list several important rivers and their importance to the exploration and development of the areas through which they flow.
4. The students will explain why certain animals and men inhabit the same areas.

Activities at School

1. Visit the Fort Collins Museum.
2. Make a time line of the past 200 years in Larimer County.
3. A speaker on Mexican-American activities in the southwest (Bill Lopez).
4. Build a miniature early Colorado community.

5. Build a log cabin, using pretzels and milk cartons.
6. Make a list of current local names that have been historically important.
7. Make a list of local terms, their significance and meaning to the early settlers, i.e., cache, poudre, LaPorte, rendezvous, etc.
8. Trace the history of the army in Fort Collins. Where was the fort, etc.?
9. Discuss the economics of trading in the 1800's, i.e., what items did different groups depend on others to bring, etc.

Activities at Center
1. Describe the area as it might have looked before mankind came.
2. Relate the council circle to those of early settlers and Indian customs.
3. Conduct a mock trading session in a council or rendezvous style.

## Theme XV: It is important to be able to communicate your feelings. (Language Arts)

Basic Concepts
1. Good grammar is essential for understanding in communication.
2. Increased vocabulary gives greater meaning in communication.
3. Different words portray different pictures or ideas.

Behavioral Objectives
1. The student will be able to write a descriptive poem about the outdoors.
2. The student will write a descriptive paragraph about the outdoors.
3. The student will write a list of adjectives.
4. The student will demonstrate library skills by writing a report.

Activities at School
1. Read poems and stories describing nature and the outdoors.
2. Spelling and dictionary words using new vocabulary.
3. Find poems about nature for a bulletin board display.
4. Research one object of nature seen at the center.
5. Write a book report on an outdoorsman, explorer, scout, trader, etc.
6. List names used in the Fort Collins area. Research for origin and meaning.
7. Write plays about outdoor happenings--Indians, farming, etc.

8. Illustrate stories and poems.
9. Write appropriate thank you notes.

Activities at Center

1. Take pad and pencil and write word pictures, such as "tumbling leaf," etc. Put word pictures into poems and stories.
2. Discuss how pupils' behavior would be like or different from that of a good outdoorsman.
3. Listen to taped poems and music and look for objects and sounds described.
4. Observe and then conjugate verbs such as see, saw, have seen.
5. Write a play and give it in the council ring.

Theme XVI: Physical experiences give the student another means to appreciate the outdoors. (Physical Education)

Basic Concepts

1. Proper footwear and clothing are essential for outdoor activity.
2. The student should learn some basic first aid.
3. Being outdoors is essential to one's physical and mental health.

Behavioral Objectives

1. The student will practice first aid measures, such as caring for cuts, bruises, stings, bites, sprained ankles.
2. The student will list examples of proper clothing for outdoor activity.
3. The student demonstrates basic locomotor skills.

Activities at School

1. First aid basics.
2. Softball throw.
3. Relay races.
4. Broad jump.
5. Square dancing.
6. Any outdoor sport, i.e., soccer, football, softball, etc.
7. Study Olympic games that are held outdoors.

Activities at Center

1. Throw rocks for certain distances, such as across the river.
2. Obstacle courses.
3. Relay races.
4. Jogging trails.
5. Jump over logs.
6. Jump rope.
7. Chin self on trees.
8. Balance self on logs or trees.
9. Pantomime or charades of animal movements.
10. Indian dancing around council ring.
11. Make own modern dance, such as dance of the babbling brook, falling tree, etc.
12. Walk silently in woods as Indians did.
13. Check book Nature Oriented Activities, by Smissen. This is an excellent book regarding outdoor games for elementary level.

Theme XVII: Measuring instruments strengthen intuitive feelings of distance and directions and provide skills necessary for self-reliance and confidence in the outdoors. (Mathematics)

Basic Concepts

1. The student knows linear and surface measurements.
2. Compass and map readings are important in understanding area.
3. Accurate estimating is an important form of communication.

Behavioral Objectives

1. Students will demonstrate skills in visualizing, plotting, and measuring angles and distances.
2. Student should be able to approximate an acre of land.
3. Student will demonstrate improvement in estimating distances.

Activities at School

1. Learn time-rate-distance formula and put to use, such as: How long will it take to get to center from school, downtown, other places?
2. How long it would take by: car, plane, train, etc.
3. Learn distance measures.
4. Learn skills in making elevation map (grade teacher).
5. Chart and graph information.
6. List ways in which math is used in all phases--cooking, outdoors, etc.

7. Skills in using compass.

Activities at Center

1. Teacher could make treasure map, using compass. Children solve it.
2. Students make treasure map, using compass, and exchange with other group.
3. Plot square feet, yards, acre--walk it off or pace.
4. Measure a pace for each student.
5. Figure out height of tree.
6. Measure approximate width of river, then measure.
7. Plot an elevation map of area.
8. Plot an acre of ground in different areas.

GRADES: JUNIOR AND SENIOR HIGH

## SCIENCE THEMES

### EARTH SCIENCE

Theme I: The weathering and erosion of rocks and minerals leads to the development of soils and landscapes.

**Basic Concepts**

1. To develop an understanding of natural forces and processes.
2. To develop man's potentialities and capacity for the study and understanding of nature.

Behavioral Objectives

1. The development of skills in the identification of minerals.
2. The development of skills in the identification of rocks.
3. The student will observe and explain what happens to rocks and minerals as they weather, recognize the products of weathering, and explain how these products differ from the original rock.
4. Explain why a mineral such as quartz can become separated from other weathered rock materials.
5. The student will observe and discuss the role and relative importance of erosional agents in forming the soil and shaping the landscape.
6. The student will distinguish areas of erosion from areas of deposition.
7. The student will develop the skill to examine rocks and interpret their origin.
8. The student will use the proper terminology in describing rocks and minerals.
9. The student will develop an understanding and/or be able to define what is meant by a soil.

Activities at School

1. Introduction to the terminology for the physical description of minerals.
2. The use of keys in identifying minerals and rocks.
3. Discussion on the effects of weathering.
4. Discussion on the agents of erosion.
5. With samples of different soils such as clays, silts, loams, and sandy soils, the students will identify by feeling different soils and examination under magnification.
6. Use photographs for students to give interpretations of such things as bedrock type, processes of erosion, glaciation, etc.

7. List as many soil types as found in the area.

Activities at Center

1. Identify the rock types represented in the stream boulders.
2. Identify the minerals present in the rocks.
3. Identify the rock specimens collected by the Boy Scouts from various states.
4. Interpret a possible origin for the various rocks.
5. Compare the minerals in the sandbar and the soil with the minerals present in the river gravels.
6. List the agents of erosion active in the area.

Activities at School - Post

1. Discuss the origin of the stream gravels.
2. Discuss the possible origin of the sand in the sandbar.
3. Discuss the absence of bedrock in the area.
4. Discuss the agents of erosion that have aided in the development of the present topography.
5. Compare the relative importance of the various agents of erosion that have been active in this area.

Teachers' Note:

1. The detail of identification can be varied from a very simple classification of rocks and common minerals for the young or low-ability groups to a more sophisticated classification for advanced classes.
2. Mineral and rock identification kits and books may be taken to the site to aid in identification.

Theme II: A knowledge of soils is important because soils are basic in the support of life.

Basic Concepts

1. To develop man's potentialities and capacities for the study and understanding of nature.

Behavioral Objectives

1. The student will subdivide the soil profile into soil horizons.
2. The student will identify the materials present in soil samples.
3. The student will observe the effect of climate and weathering on the formation of soil types.
4. Observe the relationship between plant types and soil types.
5. The student will become familiar with different soil types, such as clay, silt, loam, sandy and combinations of these.

Activities at School

1. Definition of soil.
2. Discussion of soil formation.
3. Laboratory exercise on the development of an "ideal" soil.
4. Laboratory exercise on identification of different soil types.
5. Laboratory exercise on identification of different materials in soils.

Activities at Center

1. Locate a typical soil profile.
2. Draw a diagram of the soil profile and label it.

Activities at School - Post

1. Discussion on the evolution of soil.
2. How was this soil profile affected by the climate in which it was formed?
3. Compare the soil profile studied in the laboratory with the one observed on the site.

Teachers' Note:

1. Students could photograph or diagram a variety of soil profiles from road ruts, riverbanks, etc.
2. Photographs of typical soil profiles may be used for the students to pick the various horizons. This activity could be used for the evaluation of student progress.
3. Students may analyze samples of various soil horizons for their mineral content.

Theme III: It is important to have a basic knowledge of maps.

Basic Concepts
1. To develop an understanding of man's cultural, social, and scientific relationships to his environment and to other human beings.

Behavioral Objectives
1. The student will recognize a variety of features on the earth's surface and will "illustrate" these features on a map.
2. The student will become familiar with the use of a compass in orienting a map and in locating features on a map.
3. The student will develop skills in the use of topographic maps.

Activities at School
1. Introduce the concept of "contour lines."
2. Familiarize the students with symbols used on maps.
3. Discuss the use and value of various types of maps (political, cultural, topographic, geologic, etc.).
4. Discuss the correct use of a compass.

Activities at Center
1. Have the students "describe" the area by drawing a map with as much detail as possible.
2. Use a compass in locating various features.
3. Compare the surface of the land with a published (USGS) topographic map.

Activities at School - Post
1. Compare the maps drawn by the students.
2. Discuss the types of features shown, the problems involved in constructing maps, the value of maps, the disadvantages of various types of maps.

Teachers' Note:
1. A prepared outline of the site may aid the students in drawing their maps. The students may be divided into groups and assigned certain maps to prepare, such as a map to show the topography only (can assume contour values or show topography by shading),

a map showing physical features such as river, wooded area, parking lot, weather station, fences, etc.

Theme IV: The movement of water is important from standpoint of erosion, sedimentation, deposition, and grading of earth materials.

Basic Concepts

1. To develop an understanding of natural forces and processes.

Behavioral Objectives

1. Develop an understanding of the "uniformity of p[illegible]"--what is taking place now can be assumed to have taken place in the past.
2. To be able to recognize and describe the formation of graded bedding.
3. Recognize and discuss the eventual destination of water in the river; namely, evaporation, infiltration, or run-off to the sea.
4. Be able to discuss the role of running water in shaping the landscape.
5. Be able to discuss the role of water in soil formation.
6. Be able to relate the amount of energy present in the stream and the amount of sedimentary load.
7. Be able to predict the relationship between stream slope and rate of erosion.
8. Be able to predict the relationship between gravity and rate of stream flow.
9. Be able to recognize areas of erosion and areas of deposition.
10. Be able to determine velocity of stream at various cross-sections and relate to stream meandering, bank cutting, and sandbar formation.
11. Be able to explain how a sandbar forms.
12. Be able to suggest ways to control erosion and aid in deposition of sediments where desirable.
13. Be able to explain how earth materials are graded by water.
14. Be able to explain why precipitation is not immediately apparent by increased stream flow.

Activities at School

1. Where does water in the stream come from?
2. What happens to the precipitation that does not reach the stream?
3. In what ways does the water move?
4. Discuss porosity, permeability, and capillarity of soils.
5. How do various soils such as heavy clays, sills, loams, and sandy soils affect porosity, permeability, and capillarity?
6. Why is rate of run-off of precipitation high in certain cases and low in other cases?

7. Discuss ground water, water table, zone of aeration, zone of saturation, and aquifers.
8. Classroom experiments in porosity, permeability, capillarity, and grading.
9. Classroom investigations on stream table.

Activities at Center

1. Analyze and sketch a generalized cross-section of a sandbar from head to lower end.
2. Measure stream flow rates at center of channel and at margins on a straightaway section of stream.
3. Do same as above on a bend.
4. Analyze sediment load in fast sections of stream and at slow sections, relative to particle sizes and quantities.
5. Study areas at the stream and away from the stream where running water has played a part in shaping the landscape.
6. Measure rate of stream flow in area of high gradient and same in area of low gradient.
7. Investigate stream deposits to see if material is haphazardly dropped or if there is some pattern to the deposition.
8. In area away from stream, dig shallow hole to some distance below water level. Besides WATER TABLE, determine area in which soil is saturated and that which is not.
9. Locate some obstructions in the stream. Analyze what is taking place.

Activities at School - Post

1. Discuss possible reasons why coarser materials are generally deposited at the head of the sandbar and finer materials progressively toward the lower end.
2. Discuss possible reasons why there are variations in particle size in various zones of a vertical section of the sandbar.
3. Discuss relationship of gradient on rate of stream flow.
4. Discuss relationship between rate of stream flow and amount of erosion.
5. Analyze and discuss results of stream flow rates at center of channel and on sides. How might this be related to erosion?
6. Discuss why certain areas of stream banks are undercutting while in other areas deposition is taking place.
7. Discuss area of stream that is carrying the greatest particle load and the part carrying the least.
8. Discuss the effect of obstructions such as rocks, driftwood, or dams on stream flow, erosion, and also deposition.

Teachers' Note:

1. Students might be interested in some outside activities such as water-treating plants or sewage-treating plants.
2. A student activity meriting further study is a forest service investigation on watersheds and the mechanics of how vegetation inhibits run-off.
3. Same as above on soil conservation investigations on contouring, small water retaining ponds, and strip planting.
4. List all ways water is withdrawn temporarily from water cycle, such as glaciers.
5. Conjecture on where water came to the earth in the first place.
6. Discuss ways in which vegetative types may be indicative of the climate.
   Films: Mountain Water
   Rivers in Miniature
   Snow
   The Water Cycle
   Waters of Coweeta
7. A visit to the CSU Foothills Hydraulic Laboratory.

Theme V: A knowledge of evapotranspiration is important to farming, crop species, and plantings. It is a guide for long-range community activity regarding water resources.

Basic Concepts

1. To develop an understanding of natural forces and processes.

Behavioral Objectives

1. Become familiar with a water budget.
2. Become familiar with the terms of evaporation, transpiration, evapotranspiration, precipitation, soil moisture storage, water deficit, and water surplus.
3. Be able to interpret the factors that affect amount of evapotranspiration.
4. An understanding of how data is collected to work up a local water budget.
5. Be able to work up a local water budget.

Activities at School

1. A discussion of the information a water budget would provide.
2. What is evapotranspiration, precipitation, evaporation, water surplus, water deficit, soil water storage, etc.
3. Discuss the mechanics of preparing a graph of a water budget.

4. Obtain monthly precipitation and potential evapotranspiration values from the weather bureau and prepare a local water budget (can be computed from Thornthwaites & Mather "Instructions & Tables for Computing Potential Evapotranspiration," Publications in Climatology, Volume X, No. 1, 1957).

Activities at Center

1. Note kinds and amounts of vegetative growth over the area, considering seasonal periods of growth and dormancy. Relate this to the local water budget previously prepared.

Activities at School - Post

1. Using photographs of typical vegetative growth in several areas of the United States, try to relate these to their water budgets.
2. Prepare a water budget for each of the areas considered in (1) above.
3. Discuss the following problems:
    - a. Why do some areas require irrigation to farm successfully?
    - b. Why do the months vary during which irrigation is used in different areas of the United States?
    - c. How do you account for the fact that in some areas there is never a water deficit?
    - d. Why is there never a soil moisture surplus in some areas?
    - e. What might be some practical applications of a local water budget?

Teachers' Note:

1. A bulletin board display of several water budgets and graphs of typical United States contrasting areas: desert, humid area, subalpine; typical photographs of vegetation of each area would be useful.
2. A water budget is like a bank account. It involves three factors: income, outgo, and storage.

Theme VI: A knowledge of weather is important because it often affects and controls our everyday activities.

Basic Concepts

1. To develop an understanding of natural forces and processes.

Behavioral Objectives

1. Become familiar with use and operation of weather instruments.
2. Be able to make weather observations; namely, obtain temperature, pressure, wind speed and direction, relative humidity and dew point, cloud types, amount of cloud cover, and amount of precipitation.
3. Be able to collect data and prepare isothermal maps.
4. Become familiar with terminology and be able to interpret weather maps.
5. Be able to develop criteria for weather forecasting to see if there is a correlation between cloud types, temperature change, barometric pressure change, wind direction, and relative humidity, and the expected change in weather.
6. Develop an interest in weather as it affects our lives and independently set up weather station or obtain additional information on the subject.

Activities at School

1. Use and care of equipment.
2. How to compute relative humidity and dew point.
3. General familiarity with important cloud families and cloud types and at level found.
4. Make weather observations each day and record (a long sheet on classroom wall for several months' observation gives good graphic, day-by-day changes).
5. Discussion of water cycle.
6. Experiments to investigate evaporation, condensation, precipitation.
7. Major air masses and development into weather.
8. Weather fronts.

Activities at Center

1. At various points over area obtain temperatures at ground level and at six-foot heights. Plot data on maps of area at each level. Draw isotherm lines to show the temperature field.
2. If recording weather instruments installed in area, make comparisons of readings with those taken at school.

Activities at School - Post

1. Discuss factors that might have caused variations within the temperature field.
2. Would the field be the same tomorrow as today?
3. Discuss possibilities that semi-permanent temperature fields exist and that these might be one controlling factor in vegetation present.

4. Discuss a possible tie-in of weather and temperature fields.
5. Discuss why we say there are "microclimates" within this area.

Teachers' Note:
1. Subscribe for daily weather maps from the Weather Bureau.
2. Films on weather:
    a. Reading Weather Maps
    b. Weather: Why It Changes
    c. What Makes Clouds
    d. Weather: Understanding Storms
    e. Weather: Understanding Precipitation
3. Prepare weather maps from Weather Bureau data.
4. Predict weather changes based on temperature, wind change, pressure, and cloud types.

Theme VII: It is important to have a basic knowledge of earth samples.

Basic Concepts
1. To develop an understanding of natural forces and processes.

Behavioral Objectives
1. The student will be able to identify various characteristics of the area by using core samples*.

Activities at School
1. Introduce students to core bore and give instructions in its use.
2. Discuss the various things that we can tell through core boring, i.e., age of tree, condition during certain years, etc.

Activities at Center
1. Each student takes two core samples. Each student takes samples from different areas of center so as to be able to compare samples from near stream bed with ones taken from some distance away.
2. Cores could also be obtained from trees with an increment borer to compare good and bad growth years and to correlate ages.

Activities at School - Post

1. Mount and diagram on chart of core samples the various features shown by samples.
2. Later, use all students' results to determine the weather conditions or various other features of the area of the nature center --relate these to the years.

Teachers' Note:

1. *A core sample is a round boring of soil horizon from surface down to several feet, obtained by a special core drill. It could also be obtained by shoveling down several feet and carefully obtaining an undisturbed section of the uncovered face.

## PHYSICAL SCIENCES

Theme I: Natural changes are affected by man's intervention in the form of pollution, depletion of resources, or mismanagement activities.

Basic Concepts

1. To develop an understanding of man's interaction with the environment.
2. To develop knowledge and attitudes favorable to conserving our natural resources.

Behavioral Objectives

1. To recognize that plant life in an area is adversely affected and to formulate reasons for this.
2. To recognize that plant life in an area has been favorably affected and to formulate reasons for this.
3. To know how water, soil, and air is polluted by man and to know the methods for determining the degree of pollution.
4. Know how water is purified.
5. Know how to gather data about interrelations of man and nature.

Activities at School

1. Investigate and report on pollution in the community (agriculture and city area).

2. Devise apparatus for purifying water.
3. Purify sample of Cache la Poudre River water.
4. Devise air sample for study of pollution particles.
5. To investigate and report on why detergents destroy plant and animal life.
6. Take pictures in the farm and ranch community of good and poor management practices.
7. To study architectural pollution.

Activities at Center

1. Visit the center with the following experiences to be chosen by the teacher and class:
    a. Visit the sewage disposal plant and observe the sewage purification process. Study the water above and below where plant returns water to the river.
    b. Observe man's disruption of nature, interpreting what happens to plant and animal life because of man's interference, i.e., trails, gravel pits, drainage ditch, etc.
2. On way to and from the center observe local buildings and how they fit into the environment.

Theme II: Natural changes in the environment occur under the influence of forces and processes acting over a period of time.

Basic Concepts

1. Man's understanding of natural forces and processes helps in the preservation of our natural resources.
2. Man must develop procedures to study, understand, and appreciate nature.

Behavioral Objectives

1. Develop rules for personal application related to conserving natural resources.
2. Know how to test the soil to determine its make-up.
3. Know how to devise sampling methods for studying plant and animal population.
4. Know how to carry out experiments dealing with transpiration rates, and be able to draw conclusions from the experiments.
5. Know how to measure stream flow.

Activities at School

1. Make a study of the water source in the Poudre River and man's efforts to conserve it.
2. Collect and display insects found in specific communities.
3. Test soil from different parts of the city and farm areas.

Activities at Center

1. Visit the center periodically with specific experiments to be carried out, i.e., measure water flow in the Poudre River, keeping charts on findings; test soil from the prairie area and contrast with soil from the "cottonwood" bottomland; make a sample population study of animals and plants in the area; make a comparison of alpine plant and animal life and that found at the center--this would necessitate a visit to Pengree Park.

Theme III: Analysis of soil for mineral content determines what vegetation can best be grown on a soil.

Basic Concepts

1. To develop man's potentialities and capacities for the study and understanding of nature.
2. To develop an understanding of natural forces and processes.

Behavioral Objectives

1. Develop skill in analysis of mineral content of soil.
2. Develop skill in obtaining pH values of soil.
3. Develop skill in sampling soil for analysis.
4. The student will develop an understanding or be able to explain why different soils vary in mineral content and pH values.
5. The student will develop an understanding of why a mineral analysis and pH analysis will determine the correct fertilizer to add.
6. The student will make observations to see if there is a relationship between minerals present or pH values and the type of vegetation growing on a soil.
7. The student will discuss the possibility that climate and/or weather may be a factor in minerals present or pH values.

Activities at School

1. Give definition of soil, mineral content, and pH.
2. List minerals found in soil and minerals required by plants.

3. Discussion on how to sample soil, analyze for mineral content, and techniques for obtaining pH values.
4. Discussion of fertilizers and on soils, minerals present, and how these minerals are made available to plants.

Activities at Center

1. Obtain random soil samples (1-6 inch level and 12-24 inch level).
2. Tabulate species of plants growing contiguous to each sampling area.
3. Note drainage at each sampling area (good or poor drainage).
4. Note whether soil has been in place for a long time or if it has been distributed by flooding.

Activities at School - Post

1. Analyze soil for mineral content.
2. Analyze soil for pH values.
3. Determine if there is a correlation between mineral content and/or pH values and plants growing at sampling area.
4. Determine if there is a marked difference in mineral content and/or pH values between samples taken from areas disturbed by floods and the undisturbed areas.
5. Students might set up sample plots in growth area and, using some seeds such as beans, fertilize, in different concentrations, and note results. (Do some in areas of low, neutral, and high pH values.)

## BIOLOGICAL SCIENCES

Theme Ia: It is important to have a basic knowledge of animals.

Basic Concepts

1. It is important to develop an understanding of natural forces, processes, and interactions of plants and animals.
2. The student will learn the principles of plant and animal taxonomy.

Behavioral Objectives

1. The student will record and explain adaptations of animals to their environment, including instincts and learned behavior (habits) shown in the animals.

### Activities at School

1. Orientation of students to basic animal psychology: instinctive behavior, learned behavior, conditioned behavior (response).
2. Acquaint students with basic terms to be used in the study of animal behavior.
3. Acquaint students with adaptive characteristics for protection among animals.
4. Suggest possible animals to observe on the site.
5. Set up format for observations.
6. Student will choose desired animal to observe and do research as to probable behavior patterns he may expect to see on the site.
7. Prepare a written report on correlation between physical and behavioral characteristics.
8. Prepare a written report describing the activities of an animal through direct or indirect observation (tracks, scat, etc.).

### Activities at Center

1. Locate animal(s) and animal signs to be observed.
2. Record observations through field notebooks and possibly photographs.
3. Build and properly use an observation station (blind).

### Teachers' Note:

1. Teacher needs to preview area to get an idea of which animals might be suitable for a study of this type.
2. It might be easier for students to work in small groups rather than singly; however, this is up to the teachers.

## Theme Ib:

### Behavioral Objectives

1. The student will conduct a survey of the mammal population of the area, using observations, live trappings, etc. (any method but killing).

### Activities at School

1. Discuss techniques of live trapping and animal care after trapping.
2. Discuss handling of wild animals due to their possibility of carrying disease (rabies, tulererimia, etc.) and insect vectors (ticks, etc.)
3. Construct live traps.
4. Set up a general plan for placement of traps.

5. Introduction to possible mammals to be found on the site. (This might also be used as a checklist on the site.

Activities at Center

1. Locate and place traps.
2. Periodically check and release animals.
3. Record habitat, time of day, behavior (free environment and trapped, if possible), sex, size, coloration, and identity.

Activities at School - Post

1. Interpret field data, habitats, behavior, density, interrelationships between different mammals, and seasonal influences.
2. Students construct an identification key for most common animals obtained in the area.

Teachers' Note:

1. During the period when traps will be checked and animals released, a group rotation basis for accomplishing this task might be set up to eliminate the problem of large numbers of students in the area at any given time.
2. Emphasize safe handling of live animals.
3. Depth of materials covered will be at the discretion of the teacher.

Theme Ic:

Behavioral Objectives

1. The student will observe and identify bird population of the site.

Activities at School

1. Preview local bird types, using slides, charts, texts, etc.
2. Familiarize students with basic internal anatomy.
3. Familiarize students with bird calls through records, etc.
4. Familiarize students with use of district-owned telescope sets.

Activities at Center
1. Observe and identify different birds and the habitat they tend to associate with.
2. Record external physical characteristics.
3. Record typical behavior of the bird.

Activities at School - Post
1. Written report on correlation between physical characteristics and behavior.
2. Written report describing the activities of the bird observed (possibly in a diary form).
3. Discuss external characteristics and their effect on behavior.
4. Design a key to identify the birds observed.

Teachers' Note:
1. Observations may be made as a list, in a diary form, at specified time intervals, written as a story by the bird on his own activities.
2. Students might observe area through changes of seasons, noting difference in population and behavior.

Theme Id:

Behavioral Objectives
1. Using the population survey method, the class will conduct the survey, collect data, interpret interrelationships between plant and animal life within the area.

Activities at School
1. Description of area.
2. Work out format for population study procedures, i.e., quadrant, animal signs.
3. Assign work groups and group leaders.
4. Set up data sheets and explain the use in order that records be as near alike as possible.
5. Acquaint students with keys.

Activities at Center

1. Plant population counts using quadrants: trees, shrubs, herbs (note cover provided by each of the above and species).
2. Searching and studying litter and soil, using quadrants.
3. Netting insects and studying larger animals through observation or signs, count and identify.

Activities at School - Post

1. Compile data from all groups.
2. Draw conclusions as to interrelationships and community structure of plants and animals within the quadrant.

Teachers' Note:

1. Refer to BSCS laboratory manual--green version for suggested population study procedure.
2. Teacher needs to preview area carefully before making plans for class use of the area.

Theme IIa: Natural processes play an important part in the determination of environment.

Basic Concepts

1. To develop an understanding of natural forces and processes.
2. The student will understand and develop an appreciation for ecology.
3. The student will appreciate the influence that environmental changes have on animal and plant life.

Behavioral Objectives

1. The student will be able to measure and interpret pH, thermal differences, and pollution effects on aquatic environments.

Activities at School

1. Explanation of pH and standard methods of determining pH, i.e., litmus.
2. Introduction to thermal layers.
3. Define pollution terminology.
4. Set up format for recording data.

5. Assign groups and group leaders.
6. Devise equipment for collecting water from various levels.
7. Discuss principles of liminology.

Activities at Center

1. Test for pH in various aquatic environments on the site.
2. Set up equipment, measure, and record.
3. Collect water samples from various aquatic environments.

Activities at School - Post

1. Compile and organize pH data.
2. Compile and organize thermal data.
3. Test water samples for abiotic pollution.
4. Test water samples for biotic pollution.
5. Compile and organize pollution data.
6. Draw conclusions between pH, thermal differences, and pollution, and the aquatic habitat from which they were taken.

Teachers' Note:

1. Students may need some practice in determining pH, reading thermometers, and methods of chemical analysis of water samples before going to the nature center area.
2. Preliminary survey of aquatic areas of center by teacher will be necessary to guide students.

Theme IIb:

Behavioral Objectives

1. The student will be able to collect average monthly temperatures and precipitations, and draw a climatogram to relate conclusions to the type of habitat or biome.

Activities at School

1. Introduce students to methods used by meteorologists in collecting and recording data.
2. Set up a format for collecting and recording data.
3. Devise equipment for measuring temperature and precipitation.
4. Assign students to groups to survey various habitats.

5. Practice graphing data.
6. Review climate and micro-climate.

Activities at Center
1. Set up or utilize present equipment for a pre-determined period of time.
2. Collect and record data.

Activities at School - Post
1. Compile and organize data from entire experimental period.
2. Draw climatogram.
3. Relate data obtained in climatogram to type of habitat or biome.

Teachers' Note:
1. Records of temperature and precipitation are available from CSU.
2. Guides for construction of equipment are available in the form of published literature.
3. Group rotation for collecting and recording data should be set up so that it becomes the responsibility of all involved.
4. As an appropriate introduction and conclusion to curriculum guide, emphasize: (a) refrain from destroying plant and animal life, (b) restore the area to the original conditions after use, and (c) be economical in the use of resources.

## Theme III: Plant classification.

Basic Concepts
1. To develop man's potentialities and capacities for study and understanding of nature.

Behavioral Objectives
1. The student will identify a number of families of plants found in Colorado.

Activities at School
1. Introduce plant classification.

2. Identify plant families and give identifying characteristics for each family.
3. Practice identification in class, using mounted specimens.

Activities at Center

1. Locate as many different plants as possible.
2. Draw and identify (as closely as possible) the plant families found.

Activities at School - Post

1. Have students compare drawing and identification made in the field.
2. Discuss characteristics of plants found in nature center.
3. Have students design a key for identification of plants in the nature center.

Teachers' Note:

1. Remind the students to include aquatic plants in their identification.
2. Teacher may limit plants identified to tracheophytes or angiosperms or dicots, etc.

Theme IV: Decomposition processes play an important part in the determination of environment.

Basic Concepts

1. To develop an understanding of natural forces and processes.

Behavioral Objectives

1. The student will observe and record the stages of decomposition--both biotic and physical.

Activities at School

1. Define decomposition of organic material.

2. Differentiate between decomposition by biotic means and by physical means.
3. Discuss the factors involved in decomposition.

Activities at Center
1. Find areas of decomposition.
2. Identify means of decomposition.
3. Identify organisms involved in different types of decomposition.

Activities at School - Post
1. Discuss decomposition over a long period of time. (What would happen if decomposition stopped?)
2. Discuss how man has affected decomposition.

Teachers' Note:
1. Some type of key should be available to help students identify decomposition in the field. Complexity depends on the teacher and the class.

## Theme V: Succession processes.

Basic Concepts
1. To develop an understanding of natural forces and processes.

Behavioral Objectives
1. The student will describe what succession is, what steps are involved, and give an example observed at the nature center.

Activities at School
1. Introduce succession to students.
2. Discuss types of succession.
3. Set up an ideal ecological succession, both terrestrial and aquatic (dry laboratory).
4. Discuss factors that may interrupt the process of succession.

5. Discuss differences between plant and animal succession.

Activities at Center

1. Locate as many different stages of succession as possible and plot on a map of the area.
2. Locate and identify areas where succession has been stopped and plot on a map.
3. Identify probable causes of why succession was stopped.
4. Try to identify probable plant species to move back into an area.

Activities at School - Post

1. Interpret the data collected.
2. Relate succession in the nature center to the nature center ecosystem.

Teachers' Note:

1. Small student groups may work better than individual students in area.
2. Be sure to cover different areas of the center and include running water and water pools in the total study.

## NON-SCIENCE THEMES

Theme I: The administration and management of our natural resources. (Social Studies)

Basic Concepts

1. The student will develop an understanding of responsibilities in care of our natural resources.

Behavioral Objectives

1. The student will name the major agencies of the Federal Government which manage natural resources.
2. Students will know the philosophies which govern the various agencies and tell how this affects the management of their lands.
3. The student will name the agencies of the state government which manage natural resources.

4. The student will know why there are natural resource agencies at all levels of government.

Activities at School

1. Have an employee of the Fort Collins Park Department visit the class and talk about managing city park resources.
2. Research the school library for information on agencies carrying out responsibilities in natural resource management.

Activities Out of School

1. Make a visit to Rocky Mountain National Park and talk with park administrators about what they do.
2. Visit the Roosevelt National Forest and have a forest ranger tell what he does.
3. Visit a national grassland or a wildlife sanctuary and talk with managers about their jobs.
4. Visit Horsetooth Reservoir and talk with managers about how they manage a county recreation resource.

Theme II: History of the conservation movement.

Basic Concepts

1. The student will understand how the conservation movement started and the nature of its growth and development.

Behavioral Objectives

1. The student will name the major landmarks in the history of conservation in America.
2. The student will know the philosophy of ownership of natural resources (game) by the sovereign and how it is held by the sovereign in trust for the people.
3. The student will know who the important individuals were in the conservation movement and their contributions (Gifford Pinchot, Teddy Roosevelt, Stephen Mather, etc.)

Activities at School

1. Have the student write a biography of one of the important conservationists with information obtained from community agencies.

2. Have the student write a report on one of the important concepts of conservation.
3. A visit by a representative of a local natural resources agency to the classroom would provide interesting concepts from the people working in the field.

**Theme III:** Man's laws help or hinder in care of the environment.

Basic Concepts

1. Each citizen must know how to make his contribution in making laws to improve the community.
2. Public apathy can be overcome through an informed citizenry.
3. Some laws need changing and new laws are needed in our rapidly changing society.

Behavioral Objectives

1. The student will draw a chart of local and state legislative procedures and write up and report on the procedures.
2. The student will read city ordinances dealing with pollution.
3. The student will know the names and locations of city and state officials and legislative bodies that are responsible for laws dealing with pollution.
4. The student will list the reasons that make enforcement of pollution laws difficult.

Activities at School

1. The students will research the ordinances dealing with pollution and report on the appropriateness of the ordinances.
2. The mayor might visit the class or an interview might be conducted on the city pollution problem or the organization of local government.
3. Write to the state and national government and get information on special agencies that are dealing with the pollution problem.
4. Write to major companies, i.e., Ford Motor Company, Phillips Petroleum, and obtain reports on their anti-pollution programs.
5. Prepare recommendations for laws related to the care of the environment.

Theme IV: Indian cultures of Area.

Basic Concepts
1. Indian tribes made many cultural contributions to the State of Colorado and the Poudre Valley.
2. Indian tribes cooperated with settlers in providing for mutual needs.

Behavioral Objectives
1. The student will write the names of four tribes of Indians which lived or hunted in the Fort Collins area.
2. The student will write a story about one Indian personality of the area.
3. The student will write one incident between the trapper and the Indian.
4. The student will write two French and four Indian words which are still used.

Activities at School
1. Make a map of Colorado, locating areas where Indian tribes lived.
2. Build Indian shelters, baskets, tools, etc.
3. Have an Indian student visit class and discuss problems facing Indians today.

Activities at Center
1. Mark trails to illustrate skill Indians used.

Activities Out of School
1. Visit the Larimer County Museum to view relics of the past from Indian cultures.

Theme V: The Poudre Valley has an interesting history in the development of the State of Colorado.

Basic Concepts
1. Man first settled in the Poudre Valley because of the rich natural resources.
2. Much of the land came under government controls for preservation and public use.
3. The Poudre water is used for city use and irrigation.

4. The valley provides a rich area for recreation and leisure.

Behavioral Objectives

1. The students will know the names of early settlers in the area and contributions they made to settlement.
2. The students will understand the state parks and forest system in the region.
3. The student will know and be able to write a list of the important resources in the valley.
4. Know the names of Indian tribes that lived in the area and know how they lived.

Activities at School

1. Prepare a scrapbook on the early history of the Poudre River.
2. Get an early pioneer to come to class with information about the valley.
3. Get a conservation agent to tell about government lands and their use.

Activities Out of School

1. Take a field trip to a scenic location, i.e., rustic settlement where Teddy Roosevelt visited, old LaPorte, waterworks. Background reading of local history might be helpful as students help plan the tour.
2. Visit the Pioneer Museum and get ideas on historical events related to the Poudre Valley.

Theme VI: There are many polluting agents in the community.

Basic Concepts

1. The length of time that nature's elements serve man will depend upon its use and care.
2. There are many dimensions to the pollution problem (noise, billboards, litter, water, air).
3. Man's future survival depends upon his care of the outdoors.

Behavioral Objectives

1. The student will be able to list several polluting agents in the community.

2. The student will understand and report on how man is disrupting his environment at the community level.
3. The student will understand and explain the condition of the air, water, and soil in the community.
4. Know how to take pictures and display them.

Activities at School

1. Prepare a scrapbook of pictures dealing with pollution in the community. It might be presented to the City Council, along with a student report.
2. Collect newspaper articles dealing with pollution.
3. Study and report on garbage collection and disposal plans in the city.

Activities Out of School

1. Students will take pictures of community pollutants (car exhaust, lumber mill, factory smoke, sewage plant, campgrounds). Slide pictures for viewing and still pictures for display would be useful.
2. Tape record the noise pollutants--traffic, factory, music, etc.
3. Prepare slide tape program for civic organization or parent organization.

Theme VII: A knowledge of topographic maps is important in the understanding and interpretation of geological and biological processes. (Geography)

Basic Concepts

1. To develop an understanding of the effects of topography on geological processes.
2. To develop an understanding of the effects of topography on biological processes.
3. The use of a compass is very important for anyone who is going hiking, hunting, fishing, etc., in mountainous or desert areas.

Behavioral Objectives

1. The development of skills in the use of a compass.
2. The development of skills in the preparation and interpretation of topographic maps.

3. The student will observe and explain the effect of topography on weather and climates; types of plants and animals in the area (ecology); rates of erosion and deposition of sediment; location of cities, transportation routes, agricultural areas, recreational areas, etc.

Activities at School

A. Use of a compass
  1. Discussion of the physical principles of the compass.
  2. Discussion of cardinal direction points and the intermediate points.
  3. Discussion of compass "bearings."
  4. Discussion of direction from an azimuth compass and a quadrant compass.
  5. Discussion on the use of an isogonic chart for compass correction.
  6. Care of the compass.
  7. Discussion of the many uses of the compass.

B. Use of topographic maps (Topographic maps of this area are available from the U. S. Geological Survey, Federal Center, Denver, Colorado.)
  1. Discussion of the scale of maps. (Topographic maps come in different scales.)
  2. Discussion of map symbols.
  3. Discussion of contour lines. (ESCP offers a very good activity, Mapping a Volcano, to illustrate the use of contour lines. Another demonstration kit illustrating the concept of contour lines is offered by Hubbard Scientific Company.)
  4. Discussion and exercises on the use of the maps.
  5. Discussion of topography and land use (agriculture, cities, etc.)

C. Construction of topographic maps (The topography of the nature center as shown on the Fort Collins Quadrangle is very generalized. This activity permits the student to prepare a map that will more adequately describe the area, as well as teaching the principles of contouring.)
  1. The ESCP investigation, Mapping a Volcano, or Hubbard's demonstration of topographic maps would be an excellent introduction to the construction of topographic maps.
  2. Take a topographic map and make a model out of styrofoam or Plaster of Paris of a portion of the map.
  3. Give the students a map with values of elevation and have the students contour the maps.

Activities at Center
- A. Use of a compass
    1. Students will orient themselves.
    2. Students will begin at a given point and follow a compass trail, using compass bearings and paced distances as a guide. (The course could be developed connecting points of biological interest or points of geologic interest, etc.)

- B. Use of topographic maps
    1. Orientation of the map.
    2. Location of topographic features on the map and the location of mapped features on the earth's surface.

- C. Construction of topographic maps
    1. Student will construct a simple surveying instrument, using a compass or level and a five-foot stick.
    2. Using the simple surveying instrument, the students can determine various elevations within the nature center. These can be plotted on a map and the points contoured.

Theme VIII: Design in nature. (Arts and Crafts)

Basic Concepts
1. To develop an awareness of natural design techniques as found in nature.

Behavioral Objectives
1. The student will record and explain examples of natural design in nature.
2. The student will observe and create drawings and paintings depicting their esthetic interpretation of nature.
3. Develop senses for effective sensitivity to the outdoors.

Activities at School
1. Orientation of students to elements and principles of design.
2. Acquaint student with terminology used in reference to design.
3. Record and explain examples of design used by man as a preliminary exercise to the student doing the exercise in natural design.
4. Set up format for observations, records, and reports.
5. Acquaint students with the layout of the nature center area.

Activities at Center
1. Locate examples of design as found in nature.
2. Record observations.
3. Draw or paint interpretations of observed natural outdoors.

Activities at School - Post
1. Prepare a report on examples of design as found in nature.
2. Sketch examples of design in natural surroundings of school.

Teachers' Note:
1. Teacher needs to preview area to determine layout of area in order to direct students on the site.
2. Depending upon length of time possible to spend at the center, sketches may be made on the site. This requires the availability of materials.
3. Students will need to work independently on this project.
4. Caution students against disturbing site.

Theme IX: Nature drawing.

Basic Concepts
1. To develop skills in using a variety of media to express nature in graphic form.
2. To develop senses for keen observation of the outdoor world.

Behavioral Objectives
1. The student will be able to use a variety of media to express nature in graphic form.

Activities at School
1. Orientation of students to various media which might be used in nature drawing (pencil, charcoal, chalk, water color, oil).
2. Acquaint student with techniques of handling a medium or media.
3. Develop skills of using a medium or media.
4. Acquaint students with layout of nature center area.

Activities at Center

1. Students tour nature trails and then choose an idea in nature to be sketched.
2. Students could photograph ideas for use at school for painting or drawing.

Activities at School - Post

1. Display class work, showing students outdoor interpretations.

Teachers' Note:

1. Teacher needs to visit the area in advance to determine layout of area in order to direct students on the site.
2. Students will need to work independently on this project.
3. Caution students against disturbing site.

## Theme X: Nature photography.

Basic Concepts

1. To develop skills in nature photography.
2. To develop skills in developing pictures.

Behavioral Objectives (assuming student knows basic photography)

1. Student will name three ways in which filters may be used in nature photography.
2. Student will name two ways in which design is similar in drawing and photography.
3. Student will name two ways in which lighting and shadows may be used to advantage in black and white photography.
4. Student will name two ways in which lighting and shadows may be used to advantage in color photography.
5. Student will describe macro-photographic techniques.
6. Student will explain how infra-red film can be used in nature photography.

Activities at School

1. Review composition.
2. Acquaint students with terminology.

3. Demonstrate macrophotographic techniques using auxiliary lenses or extension tubes.

Activities at Center

1. Student will photograph same subject, using different filters and at different times of day, keeping records.
2. Student will photograph different subjects, using infra-red film.
3. Student will experiment with macrophotographic techniques.

Activities at School - Post

1. Develop and print pictures.
2. Evaluate prints, referring to records to find optimum exposures, f stop settings, filters, etc.
3. Student could make a display of pictures, illustrating contrasts or comparisons.

Teachers' Note:

1. This unit should be taught by a photography teacher or other knowledgeable person, or help can be obtained from school or community resource people.
2. Behavioral changes 1-4 may be taught with simple cameras, i.e., Brownies using colored cellophane for filters. All others need more elaborate equipment.

Theme XI: Indian art.

Basic Concepts

1. To develop skills in the use of improvised art media and tools.
2. To develop appreciation of Indian art.

Behavioral Objectives

1. Student will know how to carry out research.
2. Student will make tools and pieces of art.

Activities at School
1. Student will carry out preliminary research and reporting on Indian artifacts.
2. Students will plan an outdoor project, using Indian art and tools, i.e., make shelter, cooking site, game trap, fishing gear, etc.

Activities Out of School
1. Locate area for work, materials, etc.
2. Student will carry out project, using only natural tools, materials.

Activities at School - Post
1. Evaluate project results in terms of following guidelines and plans. An exhibit or display could be provided.
2. Boy Scout groups could display clothing and dances for the class.

Teachers' Note:
1. Preliminary research and experience is almost a must.
2. Teacher should preview area to see what is available for use.
3. Teacher must stress conservation of natural resources as much as possible to avoid unnecessary destruction of nature center area.
4. Possible ideas: sand painting, dying (berries, bark), painting (mud, berries, leaves), collage, sculpture.

Theme XII: Outdoor crafts.

Basic Concepts
1. To develop skill in using natural materials as found in nature for a craft project.

Behavioral Objectives
1. Students will do research on natural materials as used in crafts.
2. Students will present written and/or oral reports on said materials.
3. Students will research techniques of working with a variety of materials or media.
4. Students will plan an outdoor craft project.

Activities at School
1. Student will do preliminary research and reporting on outdoor crafts and the techniques involved.
2. Student will plan outdoor craft project.

Activities Out of School
1. Locate area for work, materials, etc.
2. Student will carry out project, using only natural materials for craft.

Activities at School - Post
1. Evaluate project results in terms of following guidelines, plans, functionality of and result.
2. Display variety of outdoor crafts created by students.

Teachers' Note:
1. Teacher should preview area to determine what is available for use.
2. Teacher must stress conservation of natural resources as much as possible to avoid unnecessary destruction of nature center area.
3. Possible ideas: chip carving, pottery, textile dying, using natural objects in making of centerpieces, etc.

## Theme XIII: Cooking. (Home Economics or Recreational Skills; Outdoor Survival)

Basic Concepts
1. Develop understanding of man's ability to survive in/with nature.

Behavioral Objectives
1. He will know how to properly use common camping utensils.
2. He will learn methods of cooking without utensils.
3. He will understand the effects of altitude on cooking.
4. He will be able to purify water.

Activities at School

1. Plan menu.
2. Discuss modern food techniques, i.e., freeze-drying, dehydration, etc.
3. Care of utensils.
4. Proper care of site.
5. Study methods of cooking without utensils: pits, skewers.
6. Discuss effects of altitude on cooking.
7. Discuss chemical and heat methods of water purification.

Activities Out of School

1. Soap kettles and cover with foil.
2. Purify water.
3. Prepare variety of processed foods, using both utensil and no-utensil cooking techniques.

Teachers' Note:

1. Possible references: Boy Scout Handbook, Girl Scout Handbook, Edible Native Plants of the Rocky Mountains (H. D. Harrington)

Theme XIV: Firebuilding.

Basic Concepts

1. Develop understanding of man's ability to survive in/with nature.
2\.

Behavioral Objectives

1. The student will learn how to properly obtain firewood.
2. The student will learn the best types of wood for cooking and heat.
3. The student will learn how to properly construct a fire--for cooking and heat.
4. The student will learn how to properly extinguish a fire.

Activities at School

1. Discuss kinds of wood and their burning properties.
2. Discuss proper cutting and gathering of wood.
3. Proper way of extinguishing fires: camp fire, small area fire.

Activities Out of School

1. Collect wood.
2. Build fire--demonstration of improperly built fire.
3. Start fire--with matches, using glass and sun.
4. Extinguish fire.
5. Demonstration, possibly by ranger, of how to control small area fire.

Teachers' Note:

1. References: Boy Scout Handbook, Teachers' Curriculum Guide to Conservation, Ed. 1-12.

Theme XV: Natural shelters.

Basic Concepts

1. Develop understanding of man's ability to survive in/with nature.

Behavioral Objectives

1. The student will learn to protect himself in nature.
2. The student will be able to use natural resources to add to his comfort and rest.

Activities at School

1. How to plan for living/staying in the outdoors, i.e., locating site for a latrine, building water trench, how to construct a lean-to.

Activities at Public Camp Grounds

1. Dig trench.
2. Mark correct location for latrine.
3. Look for natural shelters--holes, caves.

Teachers' Note:

1. Might call Fish and Game Department or Forest Service for pamphlet on shelters.

## Theme XVI: Emergency survival - first aid.

Basic Concepts
1. Develop understanding of man's ability to survive in/with nature.

Behavioral Objectives
1. To help student become familiar with how to give immediate and temporary care to the victim of an accident or sudden illness until the services of a physician can be obtained.

Activities at School
1. Divide students into groups to find out procedures for the following types of injuries: minor wounds, nose bleeds, shock, artificial respiration, bites--snake and spiders (ice-pack method), fainting, sun stroke, sprains, burns.
2. Discuss different methods of bandaging, making a sling, tourniquet, carrying a person, making a stretcher.

Activities at Center
1. Mock accident and students will handle it--get school nurse to assist or someone from the fire department.

Teachers' Note:
1. Reference: First Aid Book, doctor, Fire Department.

## Theme XVII: Emergency survival - finding food.

Basic Concepts
1. Develop understanding of man's ability to survive in/with nature.

Behavioral Objectives
1. The student will recognize common edible plants.
2. The student will prepare and eat common edible plants.
3. The student will know the test for determining the edibility of an unknown food, see Harrington, H. D.: Edible Native Plants of the Rocky Mountains, p. 4.

4. The student will recognize signs indicating the presence of mammals.
5. The student will learn simple trapping methods.

Activities at School
1. Identify edible and poisonous plants.
2. Learn methods of preparing plant and animal life (see also Outdoor Cooking theme).
3. Students will learn animal signs, i.e., tracks, runways, scat.
4. Learn trapping methods, such as pit, snare.

Activities Out of School
1. Collect and make mounts of edible and poisonous plants.
2. Collect, prepare, and eat an edible (hopefully) plant.
3. The student will find signs of mammals in the area.
4. The student will prepare a trap.

## Theme XVIII: Measurement. (Mathematics)

Basic Concepts
1. The student will develop an understanding of the application of indirect means of measuring.

Behavioral Objectives
1. Student will learn to apply mathematics (trig and geometry) in the measurement of physical objects which may require an indirect method of measurement.

Activities at School
1. Teach students how to use tangents to measure indirectly.
2. Students will use graph paper to plot and measure.
3. Review percentages.

Activities at Center

1. Assign students different objects to measure indirectly.
2. Have students measure an acre and plot, using graph paper.
3. Figure percentage of ground cover of quadrants; graph their data.

Teachers' Note:

1. Reference: Romping Through Mathematics, by Anderson.

## Theme XIX: Geometric designs.

Basic Concepts

1. The student will appreciate the relationships of nature to geometry.

Behavioral Objectives

1. The student will learn the geometric figures.
2. The student will see the various designs and figures in nature.

Activities at School

1. Study geometric shapes, planar and solid.

Activities at Center

1. Students will list all natural objects with the specific design.
2. Students will draw objects with geometric characteristics.

## Theme XX: Poetry can interpret nature. (Language Arts)

Basic Concepts

1. The student will appreciate the influence of nature on leisure literature.
2. The student will see the moods of nature and why poetry often is the vehicle for expressing this feeling.

Behavioral Objectives
1. The student will be able to visualize a scene or mood through the written word by writing in prose what was expressed in poetry or vice versa.
2. The student will try expressing an outdoor scene or feeling through poetry.

Activities at School
1. Discussion element of poetry, i.e., symbolism, narrative, Hai-Ku, lyricism.
2. Read a poem appropriate to outdoor nature center in classroom.
3. Try to recapture sights, sounds, etc., when back in the classroom.

Activities at Center
1. Actual writing experience after quiet time in area, i.e., Hai-Ku.
2. Read the same poem at the center and let the students discuss feelings.
3. Wander through the area.

Theme XXI: Creative writing and nature.

Basic Concepts
1. The student will develop his powers of observation.
2. The student will develop his imaginary powers.
3. The student will begin to express imagery to others, using the printed word.

Behavioral Objectives
1. The student will observe and write down four incidents from which to develop a paragraph or story.
2. The student will write a paragraph or story based on his observation.
3. The student will write a ballad and/or folk song.

Activities at School
1. Learn basic fundamentals of grammar and paragraph construction.
2. Using another student's observation, each student will develop a paragraph, story.

3. The history, use, composition of ballads and/or folk songs.

Activities at Center

1. Observe and experience nature firsthand.
2. Express feelings by writing about experiences.
3. Describe a scene or feeling and have other students find areas they feel fit the scene.
4. Write a ballad and/or folk song.

Theme XXII: Scientific journals.

Basic Concepts

1. The student will appreciate the role of scientific journals in research--both intellectual and laboratory research.
2. The student will learn to accurately observe and describe.

Behavioral Objectives

1. The student will learn how to use an abstract.
2. The student will have practice writing a scientific abstract.
3. The student will learn and be able to state the major format of a scientific journal, i.e., the review of literature, methods, results, conclusions.
4. The student will be able to obtain information from a scientific journal.
5. The student will keep an observation or data notebook.
6. The student will be able to give the meaning of scientific words on a test.

Activities at School

1. Reading scientific journals from several areas.
2. Find an experiment to duplicate.
3. Find an experiment with unanswered questions and carry out the experiment.
4. Write up experiment, using correct journal form.
5. Research derivation of scientific vocabulary.

Activities at Center

1. Duplicate an experiment from a journal.
2. From information from journals, devise and carry out an activity. Keep data notebook.
3. Observe an area, keeping data notebook.
4. Describe area and then have other students find the exact spot.

## Theme XXIII: Hunting. (Recreation and Physical Education)

Basic Concepts

1. The student will appreciate the philosophy of game harvesting.
2. The student will understand the legal methods of hunting.
3. The student will understand the skills in hunting safety.
4. The students will understand the proper care of animal and processing of animal after killing.
5. The student will understand the regulations on bow hunting.

Behavioral Objectives

1. The students will write five paragraphs, discussing bounties, seasons, limits, protective regulations, and licenses.
2. The student will demonstrate how to load, fire, and unload a firearm safely.
3. The student will explain orally the different processes of field dressing and preserving meat.
4. Some interested students will be able to demonstrate the use of the bow.

Activities at School

1. Discuss game harvesting.
2. Learn state rules and regulations for all forms of hunting.
3. Game warden can be used as resource person.
4. Discuss African game preserves and poaching.
5. Teach parts of gun and proper maintenance of guns.
6. Field trip to butcher to see how to cut up a deer or elk.
7. Plan gun safety program.

Activities Out of School

1. Trip to Larimer Rifle Range to fire guns and bows.
2. Skin animal and dress.
3. Visit locker plant on butchering skills.

4. Practice safety skills in outdoor exercise.

Teachers' Note:
1. This theme is most applicable during hunting season.

Theme XXIV: Fishing.

Basic Concepts
1. The student will appreciate the philosophy of fish management and harvesting.
2. The student will understand the legal methods of fishing.
3. The student will develop skills in using fishing equipment.
4. The student will develop skills in care and cleaning of fish.
5. The student will understand the regulations on fishing.

Behavioral Objectives
1. The student will write three paragraphs demonstrating his knowledge of fishing laws.
2. The student will show skills in use of fishing equipment.
3. The student will demonstrate how a fish is cleaned.
4. The student will cast effectively.
5. The student will make effective fishing lures.

Activities at School
1. Discuss rules and regulations of fishing.
2. Discuss fish rearing--field trip to Bellvue Rearing Unit.
3. Tie flies and prepare other lures.

Activities Out of School
1. Learn and try methods of casting.
2. Clean fish.
3. Observe the environment and determine desirable fishing lures.

Teachers' Note:
1. Teachers and students over age 15 need fishing licenses.

# RESOURCE MATERIALS

## Legend Identification

The following legend will prove helpful in identifying and locating sources of materials. Some of the resources are available locally, others will have to be obtained through rentals or purchase from outside the local district.

| | |
|---|---|
| IMC | Instructional Materials Center for the Poudre R-1 School District and Office of Educational Media, Colorado State University (See the Poudre R-1 Film Catalogue for recent additions.) |
| MP-CU | Mountain Plains Film Catalogue - Colorado University |
| MP-CU | Mountain Plains Film Catalogue - Colorado State University |
| MP-WU | Mountain Plains Film Catalogue - Wyoming University |
| USDAFS | United States Department of Agriculture, Forest Service |

Educators Guide to Free Film and Educators Guide to Free Materials - Educators Progress Service, Randolph, Wisconsin

Free and Inexpensive Learning Materials - George Peabody College, Nashville, Tennessee

National Tape Recording Catalogue - University of Colorado

GRADES K-1-2-3 RESOURCE MATERIALS

## SCIENCE THEMES

Theme I: Weather and its changes affect all living things.

Films
1. Climate and the World We Live In - 13½ minutes - Color - Coronet
2. Winter is an Adventure - 11 minutes - Color - Coronet
3. How Weather Helps Us - 11 minutes - 16mm. - CSU
4. Weather for Beginners - 11 minutes - 16mm. - Coronet
5. One Rainy Day - 11 minutes - 16mm. - Coronet
6. Thermometers and How to Use Them - 11 minutes - Bailey
7. Clouds Above, 2nd Ed. - 10 minutes - Bailey
8. Water, Water, Everywhere - 11 minutes - Color - Coronet
9. What the Frost Does - 11 minutes - Color - Coronet
10. Let's Learn to Predict the Weather - 11 minutes - Color - Coronet
11. Lightening and Thunder - 11 minutes - Color - Coronet
12. A Story of A Storm - 11 minutes - Color - Coronet
13. Arctic Borderlands in Winter - 11 minutes - Color - Coronet
14. Winds That Kill - 13½ minutes - 16mm. - U. S. Weather Bureau - FREE
15. You and the Weather - 25 minutes - 16mm. - Texaco, Inc. - FREE
16. Wind at Work - 11 minutes - Color - Bailey

Filmstrips
1. Our Weather - IMC
2. Wind and Rain - IMC
3. Our Weather - Filmstrip Series No. 8320 - Encyclopedia Britannica

Recordings
1. A Rainy Day - IMC
2. Snow in the Night - IMC

References
Study Prints:
1. Poetry - It's Raining! It's Pouring! - IMC

Books:
1. Schneider, Herman. Everyday Weather and How it Works.
2. Bale, R. O. Stepping Stones to Nature.
3. Bonsall, G. The How and Why Wonderbook of Weather. Columbus: Merrill.

4. Jordan, Helen. Seeds by Wind and Water. New York: Crowell, 1962.
5. Waller, Leslie. *A Book to Begin on Weather*. New York: Holt, Rinehart & Winston, 1959.

Theme II: Living things around us change with the four seasons.

Films

1. Summer is an Adventure - 11 minutes - Color - Coronet
2. Spring is an Adventure - 11 minutes - Color - Coronet
3. Fall Brings Changes - 11 minutes - CSU
4. Winter on the Farm - 11 minutes - CSU
5. Summer on the Farm - 11 minutes - CSU
6. Spring on the Farm - 11 minutes - CSU
7. Autumn (Spring, Summer, Winter) is an Adventure - 11 minutes - CU, CSC
8. Autumn Color - 7 minutes - CU
9. Seasonal Changes in Trees - 10 minutes - CU, CSC
10. Seasons of the Year - 11 minutes - Color - Coronet
11. Animals in Autumn (Spring, Summer, Winter) - 10 minutes - CSU
12. Spring Comes to the City - 11 minutes - Coronet
13. Causes of the Seasons - 11 minutes - Color - Coronet
14. Birds in Winter - 11 minutes - Color - Coronet
15. Effects of Seasonal Change - Unit E-3 - 8mm. film loops 5021 - Mountains; 5351 - Arctic Thaw - Part I; 5351 - Arctic Thaw - Part II; 5501 - Seed Dispersal; 5503 - Seeds Sprouting; 5505 - Fruit Ripening
16. The Apple Trees: Four Seasons - 8mm. film loops - Color - No. 80728 Encyclopedia Britannica
17. The Winter Woods - 11 minutes - 16mm. - Tennessee Game and Fish Commission - FREE
18. Spring Comes Again: A Story of the Four Seasons - 10 minutes - Bailey
19. Adventures of Junior Rain Drop - 8 minutes - USDAFS

Filmstrips

1. The Snowy Day - From Set 15 of Western Woods - SFS
2. Spring is Here - IMC
3. Trip to the Autumn Woods - IMC
4. In the Autumn (Spring, Summer, Winter) - IMC
5. Seasons of the Year - IMC
6. Seasons Come and Go - Shortstrip Series No. 9900 - Encyclopedia Britannica
7. What is Weather - Shortstrip Series No. 9900 - Encyclopedia Britannica
8. Spring (Summer, Fall, Winter) - Filmstrip Series No. 10660 - Encyclopedia Britannica

9. The Seasons - Filmstrip Series No. 8320 - Encyclopedia Britannica
10. A Time of Preparing - Filmstrip Series No. 1084C - Perri - Encyclopedia Britannica
11. Filmstrip Series No. 11110 - Series of 5 in a Box - Encyclopedia Britannica

Recordings

References

Study Prints:

1. Seasons Theme - IMC

Books:

1. Bancroft & Van Gelders. Animals in Winter. New York: Crowell.
2. Why Leaves Change Color. U. S. Department of Agriculture (pamphlet)

Theme III: Students are resource users as well as resource savers.

Films

1. Conservation for Beginners - 11 minutes - 16mm. - Coronet
2. Heritage of Splendor - 16mm. - IMC
3. How Plants Help Us - 11 minutes - Color - Coronet
4. How Trees Help Us - 11 minutes - Coronet
5. We Share This Land - 14 minutes - 16mm. Sound - Soil Conservation Service - FREE
6. Forest Conservation - 11 minutes - Color - EBF
7. Smokey Bear Series - 4-12 minutes - USDAFS

Filmstrips

1. The Meaning of Conservation - McGraw-Hill
2. Conservation Series - IMC
3. Man Inherits the Earth - IMC
4. Conservation Series from SVE (for primary **grades**)
5. A Picnic for Dick and His Friends
6. Sonny Squirrel and the Pine Tree
7. Susan and the Forest Fire
8. The Muddy Raindrops

9. The Meaning of Conservation - McGraw-Hill
10. The Story of the Earth We Find in Rocks
11. Living Things Need Each Other - Encyclopedia Britannica - $6

Recordings
1. How Do We Hear Sounds - IMC

References

Study Prints:
1. Conserving our Natural Resources - IMC
2. Conservation Nystrom - IMC

Books:
1. U. S. Department of Interior and Land Management. Johnny Horizon Program.
2. Gates, Richard. The True Book of Conservation. Chicago: Children's Press, Inc.
3. Randall, C. E. You Can Be a Conservationist. American Forestry Association, 919 - 17th Street, N.W., Washington, D. C.
4. Weaver, Richard. Handbook for Teaching of Conservation and Resource Use. Danville Interstate Publishers.
5. Shannon, Terry. About the Land, the Rain, and Us. Chicago: Children's Press, 1963.
6. Syrocki, B. John. What is Soil? Chicago: Benefice Press, 1961.
7. Bartlett, Margaret F. Down the Mountain. New York: Scott, 1963.

Pamphlets:
1. Smokey Bear's Story of the Forest. USDAFS.
2. Ranger 'Rithmetic for First and Second Grade. USDAFS.
3. Color Sheets - Smokey the Bear. USDAFS.

Theme IV: In many ways animals are the same, and in many ways they are different. These characteristics help animals live in certain communities.

Films
1. Birds in Winter - 16mm. - CSU
2. Bird Homes - 16mm. - CSU

3. Animals in Autumn (Spring, Summer, Winter) - 16mm. - CSU
4. Animals and Their Homes - 10 minutes - 16mm. - CU, CSC
5. Animals and Their Foods - 10 minutes - 16mm. - CU, CSC
6. Animals at Work in Nature - 10 minutes - 16mm. - CU, CSC
7. Animal Habitats - 10 minutes - 16mm. - Utah University
8. Animal Movements - 10 minutes - 16mm. - CSC
9. Animals are Different and Alike - 11 minutes - 16mm. - Coronet
10. Animals Hide and Seek - 11 minutes (camouflage) - 16mm. - Coronet
11. Small Animals Protect Themselves - 11 minutes - Bailey
12. Winter on the Farm - 16mm. - CSU
13. Adventures of a Chipmunk Family - Encyclopedia Britannica
14. Our Animal Neighbors - Coronet
15. Wildlife World - 30 minutes - 16mm. - New Mexico Department of Dev., Santa Fe
16. World of Insects - 22 minutes - 16mm. - Chevron Chemical Company

Filmstrips

1. Insects Get Ready for Winter - IMC
2. Animals Ready for Winter - IMC
3. Birds Get Ready for Winter - IMC
4. Birds and Homes - IMC
5. How Animals Live - IMC
6. Animal Homes - IMC
7. Birds and the Countryside - IMC
8. Birds of Forest and Woodland - IMC
9. How Color Protects Animals - IMC
10. Animals in the Spring - IMC
11. Birds in the Spring - IMC
12. Insects in the Spring - IMC
13. Animals of North America - IMC
14. Plants and Animals of Desert - IMC
15. Plants and Animals of Sea - IMC
16. Learning About Mammals - Encyclopedia Britannica
17. Learning About Birds - Encyclopedia Britannica
18. Learning About Amphibians - Encyclopedia Britannica
19. Learning About Reptiles - Encyclopedia Britannica
20. Learning About Insects - Encyclopedia Britannica
21. How Color Protects Animals - IMC
22. Animals and Their Homes - IMC
23. Home for Water Plants and Animals - IMC
24. Cooperation Among Plants and Animals - IMC

Recordings

References

Study Prints:

1. SVE Colored Pictures from IMC

Books:

1. Schapp, Maratha and Charles. Let's Find Out About Animal Homes.
2. Allen, Gertrude. Everyday Animals. Boston: Houghton-Mifflin.
3. Hoover, Helen. Animals at my Doorstep. New York: Parents Magazine Press.

Theme V: Plants of any community are dependent on their environment to meet their daily needs.

Films

1. Plants are Different and Alike - 16mm. - IMC - CSU
2. Green Plants and Sunlight - 16mm. - Encyclopedia Britannica Film
3. Learning about Flowers - 10 minutes - 16mm. - CU
4. Learning about Seeds - 10 minutes - 16mm. - CU
5. We Get Food from Plants and Animals - 10 minutes - 16mm. - CSU
6. Treasures of the Forest - 14 minutes - 16mm. - CSU
7. What Plants Need for Growth - 10 minutes - 16mm. - CSU
8. Let's Visit a Tree Farm - 11 minutes - Color - Coronet
9. Let's Watch Plants Grow - 11 minutes - Color - Coronet
10. Seeds Grow into Plants - 11 minutes - Color - Coronet
11. Why Plants Grow Where They Do - 11 minutes - Color - Coronet
12. Adaptations of Plants and Animals - 13½ minutes - Color - Coronet

Filmstrips

1. What Is: Plant - IMC
2. Growing New Plants #1, #2 - IMC
3. Plants and Animals of the Desert - IMC
4. Plants and Animals of the Sea - IMC
5. How Plants Live - IMC
6. Seeds Travel - IMC
7. Learning about Plants - Series of 6, No. 9430 - Color - Encyclopedia Britannica
8. Plants Around Us - Series of 12 Shortstrips, No. 9960 - Color - Encyclopedia Britannica

Recordings

References
Study Prints:
1. Plants and Seeds - Cook - IMC

Books:
1. Neyrath, Marie. How Plants Grow. New York: Sterling.
2. Bulla, Clyde. A Tree is a Plant. New York: Crowe II.
3. Jordan, Helene. How a Seed Grows. New York: Crowe II.
4. Blough, Glen. Discovering Plants. New York: McGraw-Hill.
5. Lubell, Winifred Cecil Lumbell. Green is for Growing. Chicago: Rand-McNally.
6. Shannon, Terry. Wonderland of Plants. Chicago: Whitman.

Theme VI: Soil is made up of decaying organic material. Soil helps provide our food; consequently, we must learn to use the soil wisely.

Films
1. Rocks that Form on the Earth's Surface - 16mm.
2. The Soil and Life - 14 minutes - 16mm. - United World Film
3. Finding Out About Rocks - 14 minutes - 16mm. - United World Film
4. Soil: What It Is and What It Does - 11 minutes - Color - Coronet

Filmstrips
1. Saving the Soil - IMC
2. The Muddy Raindrops - JVE
3. The Meaning of Conservation - McGraw-Hill
4. How Rocks are Formed - IMC
5. How Soil is Formed - IMC
6. The Changing Face of the Earth
7. The Soil

Recordings
1. What are Rocks?

References
Study Prints:

Books:
1. Colby, C. B. Soil Savers. New York: Coward & McCann.
2. Colorado State Department of Education Curriculum Guide in Conservation.
3. Shannon, Terry. About the Land, Rain, and Us. Chicago: Children's Press.
4. Bartlett, Margaret. Down the Mountain. New York: Scott.
5. Syrocki, John. What is Soil? Chicago: Benefice Press.
6. The Soil that Went to Town. Soil Conservation Office (pamphlet).

Theme VII: Outdoor experiences in art appreciation.

Films
1. Birds of the Woodlands - 11 minutes - CU
2. Colors are Useful - 11 minutes - BYU (p.i.)
3. Clouds Above - 10 minutes - CSC (p.i.j.)
4. Backyard Artist - 10 minutes - Bailey
5. Color for Beginners - 11 minutes - CSU
6. Discovering Ideas for Art - 11 minutes - CSU
7. Learning with your Senses - 11 minutes - CSU

Filmstrips
1. Color - IMC
2. Lines - IMC
3. Shapes - IMC
4. Art is Everywhere - IMC
5. Texture - IMC
6. Form - IMC
7. Space - IMC

Recordings

References

Study Prints:

Books:
1. Elementary Art Guide, State of Washington, Olympia, Washington, Superintendent of Public Instruction, 1961.

2. Jefferson, Blanche. My World of Art. Belmont, California: Allyn & Bacon, Inc., 1964.
3. Perard, Victor. Drawing Sea and Water. New York: Pitman Publishing Corp., 1948.
4. Perard, Victor. Drawing Trees. New York: Pitman Publishing Corp.
5. Reynolds, H. Atwood. Complete Book of Modern Crafts. New York: Blue Ribbon Books, 1938.
6. Van Der Smissen, Betty and Oswald H. Goering. Nature - Oriented Activities, 2nd Ed. Ames, Iowa: Iowa State University Press. IMC
7. Curriculum Guide in Conservation Education, Colorado State Department of Education. IMC

Theme VIII: Develop the understanding of the child's place and responsibility in outdoor citizenship at home and in the community.

Films

1. Community Health in Action (p.i.) - 23 minutes - CU
2. My Own Yard to Play In - Black and White - Sound - Edward Harrison Motion Pictures, 1501 Broadway, New York City
3. Developing Responsibility - 10 minutes - CSU
4. Yours, Mine, and Ours - 11 minutes - CSU
5. Our Family Works Together - 11 minutes - CSU
6. Everyone Helps in a Community - 13 minutes - CSU
7. School Helpers - 9 minutes - Sigma - CSU
8. Viewpoint - 25 minutes - USDAFS
9. Voices of the Forest - 27 minutes - USDAFS
10. Smokey the Bear Series - 4-8 minutes - USDAFS
11. Woodland Manners - 14 minutes - USDAFS

Filmstrips

1. Community in Action - IMC
2. Country Community - Set of 6 - IMC
3. Town Community - Set of 6 - IMC
4. Safety Stories (Set) - Home, Play, School, Street, Vacation, and Safety Helpers - IMC

Recordings

1. School Safety Rules - IMC
2. Bicycle Safety Rules - IMC

References

Study Prints:

1. Keeping the City Clean and Beautiful

Books:

1. Bulletin on Conservation Education, No. 20 and No. 21. The Conservation Foundation, 1250 Connecticut Avenue, N.W., Washington, D. C. 20036
2. Our Land of Plenty - Little Wonder Book No. 501. Columbus, Ohio: Chas. E. Merrill Co.
3. Environmental Education. National Wildlife Foundation, 1412 - 16th Street, N. W., Washington, D. C. 20036
4. Nature Games and Activities - Poudre R-1
5. Enjoying the Outdoors with Children. Lucille Hein Assn. Press.

Theme IX: Stimulation and development of language outdoors.

Films

1. The Fish that Almost Drowned - CSU
2. Hunter and the Forest - 8 minutes - CSU
3. Karochan, the Little Bear - 11 minutes - CSU
4. Raccoon's Picnic - 5 minutes - CSU
5. Robin Redbreast - 10 minutes - CSU
6. Spunky, the Snowman - 8 minutes - CSU
7. Sound for Beginners - 11 minutes - CSU

Filmstrips

1. Billy Beaver - IMC
2. Biggest Frog in the World - IMC
3. Gray Squirrel - IMC
4. Hoppy, the Rabbit - IMC
5. Rings, the Raccoon - IMC
6. Over in the Meadow - IMC
7. I Like Pets - IMC

Recordings

References

Study Prints:

1. It's Raining! It's Pouring!
2. Leaves and the Wind

Books:

## SCIENCE THEMES

Theme I: All living things depend upon green plant food.

Films

1. How Green Plants Make and Use Food - 11 minutes - Coronet - 16mm.
2. Plants that Grow from Leaves, Stems, Roots - 11 minutes - 16mm. - Coronet
3. Plant Life at Work - 16mm. - CSC
4. Plant Motions Roots, Stems, Leaves - Basic Life Science Series
5. The World of Green Plants - Encyclopedia Britannica
6. Plants are Different and Alike - IMC*
7. How Plants Help Us - 12 minutes - 16mm. - McGraw-Hill
8. Growth of Plants - 12 minutes - 16mm. - CSU

Filmstrips

1. What is a Plant - IMC
2. Let's Learn About Seeds - IMC*
3. Plants are Living Things - Encyclopedia Britannica
4. The Structure of Plants - Encyclopedia Britannica
5. Green Plants are Important to Us
6. Leaf System - Transparency - IMC*

Recordings

References

Study Prints:

Books:

1. Curriculum Guide in Conservation, Colorado State Department of Education.
2. Kurtz, Edwin. Adventures in Living Plants. Tucson: University of Arizona Press.
3. Lubell, Winifred, and Cecil Lubell. Green is for Growing. Chicago: Rand-McNally.

Theme II: It is important for man to know that plants are classified according to their unique functions.

Films

1. Plants are Different and Alike - 12 minutes - 16mm. - CSU
2. Green Plants - 10 minutes - 16mm. - McGraw-Hill
3. Fungus Plants - 10 minutes - 16mm. - CU
4. Life of Molds - 10 minutes - 16mm. - CU
5. Why Foods Spoil, Molds, Yeast, Bacteria - 10 minutes - 16mm. - Encyclopedia Britannica
6. Plant Life #2 Fungi - 16mm. - Encyclopedia Britannica

Filmstrips

1. Non-green Plants - IMC*
2. What is a Plant? - IMC
3. How Plants Live and Grow - IMC

Recordings

References

Study Prints:

1. Making Our Own Collection - Plants and Seeds

Books:

1. Christensen. Common Edible Mushrooms. Newton Center, Massachusetts: C. T. Branford Co.
2. Smith, A. H. The Mushroom Hunters Field Guide. Ann Arbor, Michigan: Michigan Press.
3. Cornell Science Leaflet, Volume 56, No. 3, (March, 1963).
4. Brennan, Mathews. Teacher Curriculum Guide to Conservation Education, Outdoor Classroom.*
5. Liverworts, Cornell Science Leaflet, Volume 57, No. 4 (1964).
6. Fungi, Cornell Science Leaflet, Volume 56, No. 3 (1963).
7. Ferns, Cornell Science Leaflet, Volume 58, No. 4 (1965).

Theme III: If man upsets the balance of nature, it will affect his very existence.

Films

1. Conservation of Natural Resources - 11 minutes - 16mm. - CU
2. Heritage of Splendor - 16mm. - CSU
3. Nation of Spoilers - 12 minutes - 16mm. - CSU
4. Treasures of the Forest - 12 minutes - 16mm. - CSU

Filmstrips

1. Conservation Series - 35mm. - IMC
2. Man Inherits the Earth - 35mm. - IMC
3. Oil from Earth to You - 35mm. - IMC
4. Using Our Forests Wisely - 35mm. - IMC
5. Combating Insect Pests - 35mm. - IMC
6. Exploring Water Resources - 35mm. - IMC
7. Balance Among Living Things - 35mm. - IMC

Recordings

References

Study Prints:

1. Conserving Our Natural Resources - IMC
2. Earth Science - Erosion - IMC

Books:

1. Perry, John. Our Polluted World; Can Man Survive? New York: Franklin Watts, 1967.
2. Soil Means Life. National Wildlife Federation, 1412 - 16th Street, N. W., Washington, D. C. 20036 (pamphlet).
3. Dudley, Ruth. Partners in Nature. New York: Funk and Wagnalls.
4. Decay, Cornell Science Leaflet, Volume 54, No. 4 (1966).
5. Conservation, Cornell Science Leaflet, Volume 56, No. 4 (1963).
6. Food Chain, Cornell Science Leaflet, Volume 55, No. 4 (1962).

Theme IV: Weather changes affect animal behavior.

Films

1. Winter on the Farm - 11 minutes - CSU
2. How Weather Helps Us - 11 minutes - CSU
3. Animals at Work in Nature - 10 minutes - CSU
4. Animals in Autumn - 10 minutes - CSU
5. Animals in Spring - 10 minutes - CSU
6. Animals in Winter - 10 minutes - CSU
7. Animals in Summer - 10 minutes - CSU
8. Arctic Borderlands in Winter - 10 minutes - CSU
9. Birds in Winter - 10 minutes - CSU
10. Climates of North America

Filmstrips

1. What is Weather? - IMC
2. Animals Get Ready for Winter - IMC
3. Autumn is Here - IMC
    - Birds Get Ready for Winter
    - Animals Get Ready for Winter
    - Insects Get Ready for Winter
4. Spring Comes - IMC
    - Animals in Spring
    - Birds in Spring
    - Insects in Spring

Recordings

References

Study Prints:

Books:

1. Bale, R. O. Stepping Stones to Nature - IMC
2. Scheider, Herman. Everyday Weather and How it Works - IMC
3. Weather Dial. Coors Brewery Company, Golden, Colorado - pamphlet - FREE.
4. Winter Twig, Cornell Science Leaflet, Volume 58, No. 2 (1965).
5. Instructions for Home Weather Forecasting, Taylor Instruction Company, Advertising Department, 95 Aimes Street (pamphlet).
6. Schmidt, Victor, and Vern Rockcastle. Teaching Science with Everyday Things. New York: McGraw-Hill (pamphlet).

Theme V: It is important to know how animals are classified for identification and study.

Films

1. How Animals Defend Themselves - 16mm. - CSU Library
2. Animals with Backbones - 16mm. - Coronet
3. Animals Without Backbones - 16mm. - Coronet
4. Fish and Their Characteristics - 16mm. - Coronet
5. Amphibians - 16mm. - Coronet
6. Reptiles and Their Characteristics - 16mm. - Coronet
7. Birds and Their Characteristics - 16mm. - Coronet
8. Mammals and Their Characteristics - 16mm. - Coronet
9. Patterns of the Wild - 26 minutes - Color - 16mm. - USDA
10. Life Story of the Earthworm - 12 minutes - 16mm. - CSU
11. Life Story of the Hummingbird - 11 minutes - 16mm. - CSU
12. Life Story of the Beetle - 11 minutes - 16mm. - CSU

Filmstrips

1. Structure of Bills - 35mm. - IMC

Recordings

References

Study Prints:

Books:

1. Animals as Parents. William Marrow and Company.
2. Big Blue Island. World Publishing Company.
3. A Book of Canadian Animals. MacMillan.
4. Meet the Mammals. Franklin Watts, Inc.
5. Great Adventures with Wild Animals. Harper and Row.
6. Pigeons Don't Growl and Bears Don't Coo.
7. Burt, William Henry, and Richard Philip Grossenheider. A Field Guide to the Mammals. Boston: Houghton-Mifflin Co. (1959).
8. Rodeck, Hugo G. Guide to the Mammals of Colorado. Boulder, Colorado: University of Colorado Museum Press (1969).
9. Berrell. Wonders of Animal Nurseries. Dodd-Mead.
10. Ravielli, A. From Fins to Hands. Viking.
11. The Look-It-Up-Book of Mammals. Random House.
12. The Larousse Encyclopedia of Animal Life. McGraw-Hill Book Co.
13. Johnson. The Story of Animals. Harvey House.

14. Anderson, Sydney. Lives of Animals. Mankato: Creative Educational Society (1966).
15. Dugdale, Vera. Album of North American Animals. Chicago: Rand-McNally (1966).
16. Book of Mammals. Time-Life Publishing Co.
17. Book of Insects. Time-Life Publishing Co.
18. Amphibians, Cornell Science Leaflet, Volume 54, No. 4 (1961).
19. Reptiles, Cornell Science Leaflet, Volume 53, No. 4 (1960).
20. Spiders, Cornell Science Leaflet, Volume 60, No. 1 (1966).

'heme VIa: Growth and development of organisms through study of life cycles.

Films
1. Growth of Seeds - 16mm. - CSU Film Library
2. How Plants Help Us - 16mm. - CSU Film Library
3. Fall Brings Changes - 16mm. - CSU
4. Garden Plants and How They Grow - Coronet
5. Flowers at Work - CSU
6. Seed Dispersal - CSU
7. Origin of Land Plants - 16 minutes - CSU

Filmstrips
1. Learning about Plants - Encyclopedia Britannica Films, Inc., San Jose State College, California
2. Plants and Their Environment - Imperial Film Company (order from John Martin Kroll, Waukegan, Illinois)
3. Plant Structure, Parts I and II - 3-M Company (transparency)

Recordings

References

Study Prints:

Books:
1. Investigations with Plants - Resource Study Units. (Order from: Nature & Science, The Natural History Press, Garden City, L.I., New York 11530)

2. Kurtz, Edwin. Adventures in Living Plants. Tucson.
3. Science Year, The World Book Science Annual, 1968. "Investigating the Earth's Surface."
4. Interdisciplinary Outdoor Education. McGraw-Hill.
5. Curriculum Guide in Conservation Education. McGraw-Hill.
6. Conservation Illustrated. McGraw-Hill.
7. Bale, R. O. Stepping Stones to Nature. McGraw-Hill.
8. Hillcourt, William. Nature Activities and Conservation. McGraw-Hill.

Theme VIb: The frog.

Films
1. The Frog - 16mm. - CSU
2. Animals in Autumn - CSU
3. Animals in Spring - CSU
4. Animals in Summer - CSU
5. Animals in Winter - CSU
6. Spring is an Adventure - CSU
7. Life Cycle of a Frog - CSU

Filmstrips

Recordings

References
Study Prints:

Books:
1. Building a Caterpillar Cage, Stepping Stones to Nature.
2. Pond Life, Cornell Science Leaflet, Volume 60, No. 2 (1967).

Theme VIc:

Films
1. The Honeybee - 16mm. - CSU

2. Monarch Butterfly Story - 16mm. - CSU
3. Spider Engineers - 16mm. - CSU
4. Battle of Beatles - CSU
5. Garden Insect Control - CSU
6. Silent Killer - CSU
7. Chemical Conquest - CSU
8. Life Story of a Wasp - CSU

Filmstrips

Recordings

References

Study Prints:

Books:

1. Nature and Science, Volume 6, No. 16 (May 5, 1969.)
2. DeWaard, Ed. What Insect is That? Current Science, American Ed. Publication (1967).
3. Our Struggle Against Pests. (Teachers Packet) U. S. Department of Agriculture, Washington, D. C. 20250.
4. Pesticides. U. S. Department of Agriculture (pamphlet).
5. Williams, Samuel. A Laboratory and Field Guide to Biology.
6. Kalmus, H. 101 Simple Experiments with Insects. Doubleday & Co. (1960).
7. Beirne, B. P. Collecting, Preparing, and Preserving Insects. Ottawa, Canada: The Queens Printer, Canada Department of Agriculture.
8. Hillcourt, William. Nature Activities and Conservation. New York: G. P. Putnam's Sons.

Theme VII: Microscopic life in our environment influences other plant and animal life.

Films

1. Life Story of Paramecium - EBF

Filmstrips

Recordings

References

Study Prints:

Books:

1. _Microbes_, Cornell Science Leaflet, Volume 58, No. 1 (1940).
2. Grant, Madeleine. _Wonder World of Microbes_. McGraw-Hill (1964).
3. Lewis, Lucia. _The First Book of Microbes_. Franklin Watts, Inc. (1955).
4. Selsam, Millicent. _Microbes at Work_. William Morrow and Co. (1955).
5. Simon, Harold. _Microbes and Men_. McGraw-Hill (1963).

Theme VIII: Life depends upon water.

Films

1. Water's Edge - 12 minutes - 16mm. - CSU
2. How We Save Water - 10 minutes - 16mm. - CU (BFS)
3. How Water Helps Us - 10 minutes - 16mm. - CU (COR)
4. Water and What It Does - 11 minutes - 16mm. - CSC (EBF)
5. Water for Dry Lands - 20 minutes - 16mm. - CSC (DWF)
6. The Water We Drink - 11 minutes - 16mm. - CU (COR)
7. Water in the Air - 10 minutes - 16mm. - CU (CENCO)

Filmstrips

1. Exploring Water Resources - 35mm. - IMC
2. Fresh Water Pollution - 35mm.
3. Water Cycle - IMC (transparency)
4. Water, Air, and Heat - IMC (transparency)
5. Water Purification - IMC (transparency)

Recordings

References

Study Prints:

Books:

1. Leopold, Lyma B., Kenneth Davis, and Editors of Life. Water. New York: Time (1966).
2. Carr, Donald. Death of Sweet Water. New York: Norton (1966).
3. Lewis, Alfred. This Thirsty World, Water Supply and Problems Ahead. New York: McGraw-Hill (1964).
4. Riedman, Sara. Water for People. New York: Abelard-Schuman (1961).

Pamphlets:

1. The Natural Water Cycle. U. S. Department of Agriculture, Forest Service.
2. Watershed. U.S.F.S.
3. Teaching Soil and Water Conservation. U. S. Department of Agriculture, Soil Conservation Service.
4. Water. National Wildlife Federation, 16th Street, N. W., Washington, D. C. 20036.

Theme IX: The wind is both harmful and beneficial.

Films

1. Seed Dispersal - 16mm. - CSU
2. National Grasslands - 16mm. - U. S. Department of Agriculture, Forest Service.
3. Wind and What it Does - 11 minutes - 16mm. - CSC (EBF)
4. Winds and Their Causes - 10 minutes - 16mm. - CU (COR)
5. Wind at Work - 16mm. - Pat Dowling Co.

Filmstrips

1. Seed Distribution - IMC
2. Big Winds, The Destroyers - IMC
3. Why the Winds Blow - IMC
4. Wind - IMC
5. Winds - IMC (transparency)

Recordings

References

Study Prints:

Books:

1. South. People and Their Environment.
2. Carolina Conservation Curriculum Guide. Chicago, Illinois: J. G. Ferguson Publishing Company. IMC

Pamphlets:

1. Early American Soil Conservationists, Pub. No. 449, Soil Conservation Service.

Theme X: Animals exhibit different behaviors.

Films

1. Crickets: Backyard Science - 16mm. - CSU
2. Bobwhite Through the Years - 16mm. - CSU
3. Realm of the Beaver - 16mm. - CSU
4. Beatles: Backyard Science - 16mm. - CSU
5. Life Story of the Hummingbird - 16mm. - CSU
6. Common Animals of the Woods - 16mm. - Encyclopedia Britannica
7. Life Cycle of the Earthworm - 16mm. - CSU

Filmstrips

1. How Birds Get Their Food - IMC
2. Wings and Feet of Birds - IMC
3. Home for Water Plants and Animals - IMC
4. Poisonous Snakes of the U. S. - IMC
5. Nonpoisonous Snakes of the U. S. - IMC
6. Plants and Animals of the Desert - IMC
7. Bear Country - 45 Slides - CSU (slides)
8. Water Birds - 49 Slides - CSU (slides)

Recordings

1. Animals, The Craziest People - CU Tape Center, Boulder, Colorado

References

Study Prints:

Books:

1. Buchshaum, R., and M. Buchshaum. Basic Ecology. Boxwood Press.
2. Anderson, Sydney. The Lives of Animals. Mankato: Creative Educational Society.
3. Mason, George Frederick. The Wildlife of North America. New York: Hastings House, 1960.
4. Anthony. Fieldbook of North American Mammals. New York: G. P. Putnam & Sons.

Theme XI: Changing environment affects animal behavior.

Films

1. Realm of the Beaver - 25 minutes - CSU
2. Behavior of Plants and Animals - CSU
3. Animal Habitats - 11 minutes - University of Utah
4. Prairie World of the Kit Fox - 22 minutes - CSU
5. Pattern of the Wild - 27 minutes - USDAFS
6. Wild Life and the Human Touch - USDAFS - 19 minutes
7. The Living Earth Series - 40 minutes - CSU
8. Life in the Desert - 11 minutes - Encyclopedia Britannica
9. Adaptations of Plants and Animals - 13 minutes - Coronet
10. Animals and Their Homes - Coronet
11. Birds of the Prairie Marshes - 10 minutes - CU

Filmstrips

1. Communities of Living Things - 35mm. - IMC
2. Animals and People - 35mm. - IMC
3. Animal Homes - 35mm. - McGraw-Hill
4. Nature's Half-Acre - 42 Slides - CSU
5. Home for Water Plants and Animals - Slides

Recordings

References
Study Prints:

Books:

1. Schapp, Martha and Charles. Let's Find Out About Animal Homes. New York: Watts, 1962.
2. Farb, Peter. Ecology. New York: Time.
3. "Bulletin on Birds." National Audubon Society.
4. "Wilderness." USDAFS
5. Gardner, John. Junior Naturalist Workbook. Danville, Interstate Press.

Theme XII: Animal behavior is influenced by anatomy.

Films

1. Why Does the Flea Jump - CSU
2. What is a Fish? - CSU
3. What is a Mammal? - CSU
4. Birds are Interesting - 10 minutes - CU
5. Animals at Work in Nature - 10 minutes - CU
6. Animal Tracks and Signs
7. How Birds are Fitted for Their Work - Encyclopedia Britannica
8. Living Mammals - University of Utah - IFB
9. Our Animal Neighbors - 10 minutes - CSC

Filmstrips

1. Structure and Bill - IMC
2. Different Kinds of Animals (Series) - Encyclopedia Britannica
3. Water Birds - CSU - Slides

Recordings

References

Study Prints:

Books:

1. Orr, Robert. The Animal Kingdom. New York: MacMillan, 1965.
2. Gilbert, Bill. How Animals Communicate. New York: Pantheon, 1965.
3. "An Introduction to Birds." Washington, D. C., National Wildlife Federation.
4. Animal Traces, Cornell Science Leaflet, Volume 59, No. 2, 1966.

Theme XIII: Man and his mess. (Pollution)

Films

1. Wildlife and the Human Touch - CSU
2. The Litterbug - 8 minutes - BYU
3. Let's Keep America Beautiful - 14 minutes - WU
4. The Choice is Yours - 14 minutes - Audubon Film Center, Babson Park, Florida
5. Heritage Restored - 14 minutes - USDAFS
6. Our Magic Land - 16 minutes - USDAFS
7. Realm of the Wild - 25 minutes - USDAFS
8. Every Man's Empire - 18 minutes - CSC
9. Meaning of Conservation - 10 minutes - CU

Filmstrips

1. Man, An Endangered Species - 35mm. - Wards Natural Sc. Est., Inc.
2. Breaking the Biological Strand - 35mm.
3. Vanishing Species - 35mm.
4. Preserve and Protect - 35mm.
5. The Population Explosion - 35mm.
6. Soil and Erosion, A National Menace - 35mm. - IMC
7. Facts About Pesticides - 35mm. - Sound - IMC

Recordings

References

Study Prints:

1. Conserving Our Natural Resources - IMC

Books:

1. Harrison, C. William. The Challenge of Reclaiming Our Plundered Land. New York: Messner, 1963.
2. Heffernan, Helen, and George Shaftel. Man Improves His World. Syracuse: Singer, 1963.
3. Helfman, Elizabeth. Land, People, and History. New York: McKay, 1963.
4. Bronson, Wilfred. Freedom and Plenty: Ours to Save. New York: Harcourt, Brace & Co.
5. Cornell Science Leaflet, Volume 56, No. 4, May, 1963.
6. Parry, John. Our Polluted World: Can Man Survive? New York: Franklin Watts, 1967.

Theme XIV: Man settles the area.

Films

1. Lewis and Clark Expedition - CSU
2. Colorado on Parade - CSU
3. Children of the Plains Indians - CSU
4. Ghost Towns of the Rockies - CSU
5. The Last Waterhole - CSU
6. Colorful Colorado - CU
7. Colorado, the Favored Land - CU
8. Enos Mills, Colorado's First Conservationist - CU
9. See film listing from Colorado State Historical Society, Denver, Colorado.

Filmstrips

1. Colorado, the 38th State - IMC
2. Covered Wagon Days - IMC
3. Cowboys, Homesteaders - IMC
4. Rocky Mountain Area, Backbone of the Nation - IMC
5. Leaders and Outlaws - IMC
6. Before the White Man - IMC
7. Western Mining - IMC

Recordings

1. Early Fort Collins (by Miss Makepeace) - IMC

References

Study Prints:

Books:

1. Brown, R. L. Ghost Towns of Colorado Rockies. Caldwell, Idaho: Caxton Printers.
2. "History of Larimer County." Chamber of Commerce.
3. Moody, Ralph. Little Britches. IMC Library.
4. Moody, Ralph. Man of the Family. IMC Library.
5. Swift, Ernest. The Glory Trail. The National Wildlife Federation, Washington, D. C., 1958.
6. Filipiak, Jack. Our State: Colorado. Denver, Colorado: Old West Publishing Company.
7. Clapp, Joy, and Paul Stevens. Geography of Colorado. Denver, Colorado: Old West Publishing Company.
8. Frandsen, Maude Lindstrom. Our Colorado. Denver, Colorado: Old West Publishing Company.
9. Frandsen, Maude Lindstrom. High in the Rockies. Denver, Colorado: Old West Publishing Company.

Theme XV: It is important to communicate your feelings.

Films

1. Hunters Forest - 16mm. - CSU
2. Making Sense with Sentences - 16mm. - CSU
3. Communication and Our Town - 16mm. - 10 minutes - CU
4. Making Yourself Understood - 14 minutes - 16mm. - CU

Filmstrips

1. Increase Your Stock of Words - IMC
2. A Picture Has A Special Look - IMC

Recordings

1. Dust Bowl Ballads - IMC

References

Study Prints:

Books:
1. Interdisciplinary Outdoor Education Handbook, Shoreline Dist., 412 King Co., Seattle, Washington. IMC.
2. Cornell Science Leaflet, Volume 57, No. 3, March, 1964.
3. Berrill, Jacquelin. Wonder of the Woods and Desert at Night. Dodd, 1963.
4. Green. Wildlife in Danger. Coward-McCann, 1960.

Theme XVI: Physical activity in the outdoors.

Films
1. Safety Rules for School - CSU
2. I'm No Fool with Fire - CSU
3. Safety on the School Bus - CSU
4. Fitness Skills for Children - CU
5. Simple Stunts - CU

Filmstrips
1. I'm No Fool in Water - CSU
2. I'm No Fool Having Fun - CSU
3. Your Responsibilities in First Aid - Slides
4. Swimming and Diving Sequence - CSU - Transparency

Recordings

Reference
Study Prints:

Books:
1. Vander Smissen, Betty, and Oswald H. Goering. Nature-Oriented Activities. Ames, Iowa: Iowa State Press. IMC
2. Boy Scout Handbook. (Section on activities and safety.)
3. Interdisciplinary Outdoor Education Handbook. Shoreline Dist., 412 King County, Seattle, Washington.

Theme XVII: Measuring instruments strengthen intuitive feelings of distance and directions and provide skills necessary for self-reliance and confidence in the outdoors.

Films
1. Thermometers and How They Work - CSU
2. Maps Are Fun - CSU
3. Reading Maps - 11 minutes - CU
4. Let's Measure--Inches, Feet, Yards - CSU

Filmstrips
1. Measurement and Measuring - IMC
2. Early Measuring - IMC
3. Mathematics of the Honeycomb - IMC
4. How Long is a Rod - IMC
5. What is a Map - IMC
6. Measuring Distances on Maps - IMC

Recordings

References
Study Prints:

Books:
1. Schmidt, Victor, and Vern Rockcastle. Teaching Science with Everyday Things. New York: McGraw-Hill.
2. Ranger 'Rithmetic Third-Fourth, Fifth-Sixth Grade Teacher. USDAFS.
3. Outdoor Education Guide. Jefferson County Schools. (Section on compass, map-making, etc.) IMC
4. Interdisciplinary Outdoor Education Handbook. Shoreline School District, Seattle, Washington.
5. How Temperatures are Measured. New York: Tempil Corp., 132 West 22nd Street, New York, N. Y.

## RESOURCE MATERIALS

### Junior-Senior High Level

DIRECTIONS: The audio-visual and printed instructional materials at the secondary level are listed according to specific subject areas.

### Physical Sciences

16mm. Film
Filmstrips
Kits
References: Pamphlets, Books

### Earth Sciences

16mm. Film
Filmstrips
Kits
Recordings and Tapes
References: Pamphlets, Books

### Biological Sciences

16mm. Film
Filmstrips
Recordings
References: Booklets, Books

### Non-Science Themes

16mm. Film
Filmstrips
Recordings and Tapes
References: Pamphlets, Books

GRADES: JUNIOR AND SENIOR HIGH RESOURCE MATERIALS

## PHYSICAL SCIENCES

Films

1. Hunter in the Forest - IMC
2. House of Man - IMC
3. Man Makes a Desert - IMC
4. Nation of Spoilers - IMC
5. Yours Is the Land - 22 minutes - MP-CU
6. Our Soil Resources (Formation and Conservation) - 10 minutes - MP-CU-CSC
7. Man's Problem - Encyclopedia Britannica
8. Breathe at Your Own Risk - Communicable Disease Center, Atlanta, Georgia
9. Take a Deep Breath - Communicable Disease Center, Atlanta, Georgia
10. Properties of Water - Coronet
11. Rocky Mountain Area: Backbone of a Nation - IMC
12. Birth of a Volcano - IMC
13. Face of the Earth - IMC
14. Glaciers - IMC
15. Gravity - IMC
16. Ocean Tides - IMC
17. Understanding Our Earth - IMC
18. Rocks that Form the Earth's Surface - IMC
19. Treasures of the Earth - IMC
20. The Beach - IMC
21. The Changing River - 10 minutes - MP-CU
22. Conservation and Balance in Nature - 12 minutes - MP-CU
23. Nature on a Rampage - 15 minutes - MP-CU
24. Two Mighty Chasms - 12 minutes - MP-CU
25. Our Earth - 12 minutes - MP-CU
26. The Earth: Resources in Its Crust - MP-CU
27. Earthquakes and Volcanoes - MP-CU
28. Dust Bowl - MP-CU
29. Erosion - MP-CU
30. Glaciation - MP-CU
31. Understanding Our Earth - MP-CU
32. The Work of Rivers - MP-CU
33. Time Changes the Land (Geology of Zion-Bryce) - MP-CU
34. Story of the Mountains - MP-CU

Filmstrips

1. Air Pollution (What Is It?) - IMC
2. Conserving Our Natural Resources - IMC
3. Facts About Pesticides - IMC
4. Combating Insect Pests - IMC
5. Story of the Air - IMC
6. Story of the Ice and Glaciers - IMC
7. Story of Rivers - IMC
8. How the Earth Surface Changes - IMC

Recordings

Kits
1. Display and Study Collection of Rocks - IMC
2. Rocks and Minerals of Western United States - IMC
3. Ores of Common Metals - IMC

References
Booklets:
1. Audubon Nature Bulletin, Forecasting the Weather.
2. Cornell Science Leaflet, Water Wonders, Vol. 61, 1967.

Books:
1. McNall, P. E. Our Natural Resources. Danville: Interstate, 1964.
2. Davis, Kenneth. Water, The Mirror of Science. Garden City: Anchor.
3. McDivitt, James. Minerals and Men. Baltimore: John Hopkins.
4. Batton, Louis. The Unclean Sky. Garden City: Anchor, 1966.
5. Berger. Introductory Soils. New York: MacMillan, 1965.

## EARTH SCIENCES

Films
1. Great Circle - 14 minutes - MP-CSC
2. Global Concepts - 10 minutes - MP-CU
3. Latitude and Longitude - 10 minutes - MP-CU
4. Maps and Their Meaning - 15 minutes - MP-CU-CSC
5. Maps and Their Uses - 10 minutes - MP-CU-CSC
6. Reading Maps - 10 minutes - MP-CU
7. Language of Maps - IMC
8. How Weather is Forecast - 10 minutes - MP-CU
9. Weather: Why It Changes - 11 minutes - MP-WU
10. What Makes the Wind Blow - 10 minutes - MP-CSC
11. The Weather Station - 10 minutes - MP-CU
12. Winds and Their Causes - 10 minutes - MP-CU-CSC
13. Climates of North America - 15 minutes - IMC
14. Atmospheric Pressure - 11 minutes - IMC
15. Understanding Our Earth - 11 minutes - IMC
16. Wearing Away of the Land - 11 minutes - MP-CSC
17. What is Soil? - 10 minutes - MP-CU-CSC

18. Rocky Mountain Area, Backbone of the Nation - 14 minutes - IMC
19. Face of the Earth - 12 minutes - IMC
20. Mountain Water - IMC
21. Waters of Coweeta - IMC
22. Water Cycle - 10 minutes - MP-CU
23. Work of Running Water - 11 minutes - MP-CU
24. Mysteries of Water - 10 minutes - MP-CU
25. Aqua Folley - FREE - Boyd Film Co., 1569 Shelby Avenue, St. Paul, Minnesota 55104
26. Clear Water in Colorado - Bureau of Reclamation, Denver Federal Building, Denver, Colorado 80225

Filmstrips

1. Flat Maps of a Round World - IMC
2. Globes: Our Most Accurate Maps - IMC
3. Latitude and Longitude - IMC
4. Map Symbols and Terms - IMC
5. Maps: What Are They? - IMC
6. Learning to Use Maps - IMC - (Reading, measuring, locating; set of 6)
7. What is a Map? - IMC
8. Changes in Weather - IMC
9. Exploring Weather Fronts - IMC
10. Understanding Weather Conditions - IMC
11. What is Weather? - IMC
12. Why the Wind Blows - IMC
13. How Rocks Are Formed - IMC
14. How the Earth Surface Changes - IMC
15. The Story of Our Earth - IMC
16. What is a Rock? - IMC

Kits

1. Study of Soil Science
2. Soil Reaction (Soil pH)
3. Soil Nitrogen
4. Soil Phosphorus
5. Soil Humus
6. The Study of Water Quality
7. Hardness in Water
8. pH of Water
9. Taste, Odor, Color, Turbidits

(All of the above can be obtained from: LaMotte Chemical Products Company, Chestertown, Maryland 21620.)

Recordings

1. Atmosphere - National Tapes Center, Bureau of A-V Services, Boulder, Colorado
2. Meteorology - National Tapes Center, Bureau of A-V Services, Boulder, Colorado
3. Natural Resources - National Tapes Center, Bureau of A-V Services, Boulder, Colorado

References

Books:

1. Clawson, Marion, R. B. Held, and Charles Stoddard. Land for the Future. Baltimore: John Hopkins Press.
2. Carlson, Carl. Water Fit for Use. New York: Day, 1965.
3. Talley, Naomi. To Save the Soil. New York: Dial Press, 1965.
4. Keen, Melvin. The Beginner's Story of Minerals and Rocks. New York: Harper Row, 1966.
5. Thompson, Philip. Weather. New York: Time-Life, 1965.
6. Berger, Kermit. Introductory Soils. New York: MacMillan.
7. Farb, Peter. The Living Earth. Harper and Row.
8. Smith, Guy. Conservation of Natural Resources. New York: John Willey and Sons.
9. Topographical Maps. Department of Interior, Geological Survey.
10. How to Control a Gulley. Farmers Bulletin 2171. U. S. Department of Agriculture.
11. Know Your Soil. Soil Conservation Service.
12. Page, Lou. The Earth and Its Story. Columbus, Ohio: American Ed. Pub.
13. Leed, Willard. Weather and You. Columbus, Ohio: American Ed. Pub.
14. Our Polluted World. Columbus, Ohio: American Ed. Pub.
15. Physical Geography. Columbus, Ohio: American Ed. Pub.
16. Top Soil. U. S. Department of Agriculture.
17. Rudd. Pesticides and the Living Landscape. Madison: University of Wisconsin Press.

## BIOLOGICAL SCIENCES

Films - Biology and Botany

1. Succession--From Sanddune to Forest - 16mm. - MP-CU
2. Angiosperms - The Flowering Plants - 16mm. - MP-CU
3. Seasonal Changes in Trees - 10 minutes - MP-CU
4. Secrets of the Plant World - 15 minutes - MP-CU
5. Simple Plants, Algae, and Fungi - 15 minutes - MP-CU
6. Behavior in Plants and Animals - IMC
7. Flower Structure and Function - IMC
8. Growth of Seeds - IMC
9. Origin of Land Plants - Liverworts and Mosses - IMC

10. Trees, How We Identify Them - IMC
11. Growth of Plants - IMC
12. Photosynthesis (Chemistry of Foodmaking) - IMC

Films - Conservation
1. Spring Comes to the Pond - 12 minutes - MP-CU
2. Plant-Animal Communities - Changing Balance of Nature - 11 minutes - MP-WU
3. Food Cycle--Food Chain - 12 minutes - MP-WU
4. Grasslands - IMC
5. House of Man - Our Changing Environment - IMC
6. Nation of Spoilers - IMC
7. Rocky Mountain Area - IMC
8. Conserving Our National Resources - IMC
9. Forest Conservation - MP-CU
10. George Washington's River - 28 minutes - IMC
11. Treasures of the Forest - IMC
12. Wildlife and the Human Touch - USDAFS
13. Wilderness Trail - USDAFS
14. The First Mile Up - 20 minutes - McGraw-Hill
15. The Problem with Water is People - 30 minutes - McGraw-Hill

Films - Ecology
1. Bird Communities - IMC
2. Bird Homes - IMC
3. Population Ecology - IMC
4. What is Ecology? - IMC
5. Erosion - IMC
6. The Changing Forest - MP-CU
7. The Community - 11 minutes - MP-CU
8. Succession from Sanddune to Forest - 16 minutes - MP-CU
9. The World Around Us - 25 minutes - McGraw-Hill

Films - Zoology
1. One-Celled Animals - Protozoa - IMC
2. Life Story of Earthworm - IMC
3. The Frog - IMC
4. Arthropods: Insects and Their Relatives - IMC
5. Beetles: Backyard Science - IMC
6. The Honeybee - IMC
7. Life Story of the Lady Beetle - IMC
8. Life Story of the Wasp - IMC
9. Spider Engineers - IMC
10. Birds in the Winter - IMC

11. Behavior in Plants and Animals - IMC
12. Mammals of the Rocky Mountains - MP-CU
13. How Nature Protects Animals - MP-CU
14. How Insects Help Us - MP-CU
15. Insects of the Pond - MP-CU
16. Cougar - Coors Brewery

Filmstrips - Botany

1. The Aspen 37 - IMC
2. How Seeds Travel - IMC
3. Seed Distribution - IMC
4. Soil for Plants - IMC
5. Ways of Starting New Plants - IMC
6. What is a Plant - IMC
7. World of Living Things - IMC
8. Animal and Plant Communities - McGraw-Hill
9. Symbiosis - Strange Partners in Nature - Life

Filmstrips - Ecology

1. Colorado 17 - IMC
2. Facts about Pesticides - IMC
3. Life in the Pasture - IMC
4. Life in the Plains Zone - IMC
5. Life in the Mountain Zone - IMC
6. Vegetation and Man - IMC
7. The Woods or Home - IMC
8. The World of Living Things - IMC

Filmstrips - Conservation

1. Environmental Pollution: Our World in Crises; Series - Ward's Natural Science Establishment, P. O. Box 1712, Rochester, New York 14603

Filmstrips - Zoology

1. Combating Insect Pests - IMC
2. Life Story of Butterfly - IMC
3. Metamorphosis - IMC
4. Frogs, Toads, and Salamanders - IMC
5. Snakes - IMC
6. Reptiles - IMC
7. What is a Turtle? - IMC

8. Birds - IMC
9. The Prairie Dog and the Beaver - IMC
10. Rabbits - IMC
11. Rodents, the Larger Species - IMC
12. Rodents, the Smaller Species - IMC

Recordings

1. A Field Guide to the Birds - Houghton-Mifflin

References

Booklets:

1. National Wildlife Federation, 1412 - 16th Street, N. W., Washington, D. C. 20036
    a. Chemical Pesticides, A Natural Problem
    b. Wildlife of Forests and Rangelands
    c. Wildlife of Lakes, Streams, and Marshes
    d. Wildlife of Farm and Field
    e. Birds, Flowers, Trees of Our U. S.
    f. Habitat Improvement
    g. American Shame--Water Pollution
2. LaMotte Chemical Products Company, Education Products Division, Chestertown, Maryland 21620
    a. Limnology
    b. Soil Science
    c. Water Quality
    d. Environment Battles Water Pollution
3. Publications Unit, National Air Pollution Control Center, Ballston Center, Tower #2, 801 Randolph Street, Arlington, Virginia 22203
4. Cornell Leaflets Series - IMC
5. Listed pamphlets, Clean Water, Washington, D. C.
6. General Biological Supply - Turtox Leaflets, 8200 South Hoyne Avenue, Chicago, Illinois 60620
7. Air and Water Pollution Authority - 137 G Marion, Sims Building, Columbia, South Carolina
8. "Clean Air and Water in a Complex Society" - DuPont Company, Inc., Wilmington, Delaware.
9. Grass in Conservation in the United States - #TP-143, August, 1964 - SCS
10. "Outlook on Water." A Natural Resources Education Publication, Boston, Massachusetts, Department of Education, #PA 341.
11. Teaching Soil and Water Conservation. SCS
12. Teaching Conservation Through Outdoor Education Areas, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402

Books:

1. Bushsbaum, Ralph and Mildred Bushsbaum. Basic Ecology. Pittsburgh: Boxwood Press.
2. Farb, Peter. Ecology. New York: Holt, Rinehart, Winston.
3. McNall, D. E. Our Natural Resources. (2d Ed.) Danville Interstate, 1964.
4. Thompson, Philip, and Robert O'Brian. Weather. New York: Time, 1965.
5. Bold, Harold. The Plant Kingdom. Englewood Cliffs, N. J.: Prentice-Hall.
6. Worst, Judith. A Guide to North American Wildlife. New York: Bantam, 1965.
7. Orr, Robert. The Animal Kingdom. New York: MacMillan.
8. Earth Science Curriculum Project, Investigating the Earth. Boston: Houghton-Mifflin.
9. Carr, Donald. The Death of Sweet Water. New York: Norton.
10. Carson, Rachel. Silent Spring. Boston: Houghton-Mifflin.
11. McMillen, W. Bugs or People. Des Moines: Meredith.
12. Blake, Peter. God's Own Junkyard, The Planned Deterioration of America's Landscape. New York: Holt, Rinehart and Winston, 1964.
13. Smith, Frank. The Politics of Conservation. New York: Random House.
14. Odum, Eugene. Fundamentals of Ecology. New York: Holt, Rinehart and Winston.
15. Carr, Donald. The Breath of Life. New York: Norton.
16. Rudd, Robert. Pesticides and Living Landscapes. Madison: University of Wisconsin Press.
17. Carlson, Carl. Water Fit to Use. New York: Day.
18. Harrison, C. William. Conservation: The Challenge of Reclaiming Our Plundered Land. New York: Messner, 1963.
19. Day, Kenneth and John A. Day. Water: The Mirror of Science. Garden City: Anchor.
20. Helfman, Elizabeth. Water for the World. New York: McKay, 1960.
21. Riehl, Herbert. Introduction to the Atmosphere. New York: McGraw-Hill.
22. Interdisciplinary Outdoor Education Program. Shoreline School District, No. 412, Seattle, Washington.
23. People and Their Environment, Teachers Curriculum Guide to Conservation Education. J. G. Ferguson Publishing Company, Chicago, Illinois.

## NON-SCIENCE THEMES

Films

1. Mountain Water - 17 minutes - IMC
2. Last Waterhole - 20 minutes - IMC
3. Grassland - 17 minutes - IMC
4. House of Man - 17 minutes - IMC
5. Nation of Spoilers - 11 minutes - IMC

6. Rocky Mountain Area - 14 minutes - IMC
7. George Washington River - 28 minutes - IMC
8. The Last Waterhole - 15 minutes - IMC
9. Discovering Ideas for Art - IMC
10. American Indians before European Settlement - 11 minutes - MP-CU-WU
11. Use and Care of Axes and Knives - 10 minutes - MP-CU
12. Using a Compass - 11 minutes - MP-CU
13. Winter Distress Signals - 13 minutes - MP-CU
14. Autumn Color - 7 minutes - MP-CU
15. Legend of the Sioux - South Dakota Department of Highways
16. Monuments to Water - 20 minutes - Adolph Coors Company, Golden, Colorado
17. Cougar - 30 minutes - Adolph Coors Company, Golden, Colorado
18. Artificial Respiration - 10 minutes - Fort Collins Fire Department
19. In the Heart of the Rockies - Chamber of Commerce, Glenwood Springs, Colorado
20. Heritage We Guard - 30 minutes - IMC
21. What about Tomorrow's Fishing? - 13 minutes - IMC
22. Lewis and Clark - 20 minutes - IMC
23. Yours is the Land - Encyclopedia Britannica
24. State Museum Film - Denver, Colorado
    - Miners
    - Trailblazers
    - Cattlemen
    - Fur Trade
    - High Country
    - Prehistoric Man
25. The Choice is Yours - 14 minutes - Audubon Film Center, Babson Park, Florida 33827
26. Man Against Fire - 28 minutes - USDAFS
27. We're On Our Way; Teenagers and Conservation; Our American Heritage; Colorado Faces-Places-Things - Keeping Colorado Beautiful, 5850 East Jewell Avenue, Denver, Colorado 80228
28. Air Pollution -- Take a Deep Breath - 54 minutes - (3 parts) - McGraw-Hill
29. Conservation: A Job for Young America - 19 minutes - McGraw-Hill
30. We're On Our Way - 35 minutes - Denver Coca-Cola Bottling Company, 3825 York Street, Denver, Colorado 80205
31. Islands of Green - USDAFS or National Audubon Society

Filmstrips

1. Our World in Crises Series - Ward's Natural Science Est., Inc., P. O. Box 1712, Rochester, New York 14603
    - Nature of the Crises
    - Atmospheric Pollution
    - Land Pollution
    - Fresh Water Pollution
    - Marine Pollution
    - Pollution Control
2. American Indian - IMC

3. Before the White Man - IMC
4. Buffalo and Westward Expansion - IMC
5. Early Mining Town - Sound - IMC
6. First Trails Into West - Sound - IMC
7. How the West Was Won - IMC
8. Life of the Plains Indian - IMC
9. Mountain Man - Sound - IMC
10. Web of Life - McGraw-Hill
11. Conservation for Today (Series) - McGraw-Hill
12. Crises in the Environment Series: Man, An Endangered Species; Breaking the Biological Strand; Vanishing Species; Preserve and Protect; The Population Explosion - New York Times
13. Animal Locomotion - Scholastic Magazines, Inc.
14. Stress and Survival - 50 West 44th Street, New York, New York 10036

Recordings

1. Leaves of Grass - National Tapes Center, Boulder, Colorado
2. Dust Bowl Ballads - National Tapes Center, Boulder, Colorado
3. History of Fort Collins - IMC
4. Sounds of Insects - Folkway-Scholastic Records, 906 Sylvan Avenue, Englewood Cliffs, New Jersey

References

Pamphlets:

1. Edelson, Edward. The Battle for Clean Air, Public Affairs Pamphlet (250), 381 Park Avenue South, New York, New York 10016; Pamphlet No. 403. Also Pamphlet No. 421: An Environment Fit for People.
2. Game Cover, Our Habitat Hang-Up. Nebraska Game and Park Commission, State Capitol, Lincoln, Nebraska 68509
3. The Environment, What We Are Doing to It. Mountain States Telephone Company.
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    - A-8 Chemical Pesticides - A National Problem
    - A-1 By Which We Live
    - A-3 Countdown to Survival
    - A-11 America's Shame, Water Pollution
    - A-12 The Three R's and Resources
    - A-13 For the Beauty of America
5. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.:
    - Quest for Quality - Cat. No. 11.2:03 - $1
    - It's Your World - Cat. No. 11.95:5 - $2
    - The Population Challenge - Cat. No. 11.95:2 - $2
    - The Third Wave - Cat. No. 11.95:3 - $2
    - Man, An Endangered Species - Cat. No. 11.95:4 - $1.50

6. Conservation Vistas, Pacific Northwest Region, Forest Service, Portland, Oregon, U. S. Department of Agriculture
7. Communications on Environment Education (newsletter) - Colorado Department of Education, Denver, Colorado

Books:

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## IDEAS FOR EXTENSION OF THE CLASSROOM TO OUTDOORS

### I. SCIENCE

Geology

1. Determine how many different kinds of soil can be found and classify them according to their characteristics.
2. Run tests on soil for acidity, alkalinity, potassium, phosphorus, and nitrogen.
3. Make an analysis of sedimentary geologic formations.
4. Discover examples of soil erosion and causes of that erosion.
5. Collect and classify kinds of rock found in stream bed.
6. Make a study of soil temperatures at different depths and identify factors influencing the temperatures.
7. Compare the depth of topsoil at different locations and drainage patterns.
8. Examine various strata for fossils, and develop method for classification.
9. Compare the amounts of different kinds of organic matter in soil samples.

Plants

1. Survey, classify, and compare different types of plants that grow in the prairie eco system and the river bottom eco system.
2. Find evidences of attack by insects or disease on plant life.
3. Locate flowering and non-flowering plants.
4. Locate green and non-green plants.
5. Record the different kinds of trees found at the center and identify the common characteristics they exhibit.
6. Compare the various methods of seed dispersal traits of plants found at the center.
7. Mark off quadrants of one square meter in different plant communities. Compare types of plants, amount of bare ground to that covered by vegetation, light intensity, temperature, soil-air moisture, soil compactness, and water absorption rate.
8. Estimate age of living trees and amount of water given off by a tree through transpiration.
9. Identify abandoned fields in various stages of succession and compare types of vegetation.
10. Prepare a vegetation map of the outdoor nature center.
11. Students interested in photography could develop skills and take pictures of plant specimens.
12. Make a collection of seeds and record environmental conditions where they are found. Study in the laboratory for requirement for germination.
13. Make study of plants that could be used for food, fabric dyes.
14. Make study of toxic and/or poisonous plants.

Animals

1. Compare animal life found in the prairie community with that found near the river bottom.
2. Record the type and number of birds visiting a feeding station or seen at the center.
3. Examine animals found in the soil.
4. Identify and examine animal decomposers.
5. Compare the various kinds of animal tracks.
6. Observe and describe the behavior of birds.
7. Make a population census of small animals found at the nature center or of evidences of small animals.
8. Analyze the material found in nests and other protective shelters of animals.
9. Keep a record of migratory birds and the time of year they visit the center.
10. Keep a record of animal life observed at the center during the early fall and mid-winter.
11. Use the micro-bio gun (see Owen Smith). Use it to collect insects in the prairie, marsh, or pond community. Magna vials can be used to study insects at the nature center. Insects can also be mounted and displayed to compare and contrast characteristics.

Weather

1. Launch helium-filled balloons to follow weather fronts and jet streams. Students place school and address inside balloons in order that information can be returned.
2. Plan and operate a weather station. Compare temperatures at school and at the center. Make weather forecasts.
3. Compare cloud types and relate them to weather conditions.
4. Determine acidity and alkalinity of melted snow or rain.
5. Keep records of air pressure and relative humidity and relate them to kinds of weather.

Aquatic Study

1. Analyze physical characteristics of stream or pond water (pH, rate of flow, sedimentation, $O_2$ and $CO_2$, surface and depth temperatures).
2. Collect specimens of aquatic life, i.e., crustaceans (crayfish), insect larvae, in pond and stream.
3. Compare aquatic life near the sewer plant outlet and at distant points above and below that position.
4. Make studies of water specimens for bacteriological study.

## II. SOCIAL STUDIES

1. Explore the nature center and report evidences of man's disruption of nature.
2. Try a compass treasure hunt. Students in teams read compass leading to landmarks that lead the teams to the treasure.
3. Identify and contact pollution control agencies at the loc and state level.
4. Review city ordinances and discover laws relating to pollution control.
5. Photograph examples of pollution in the neighborhood and community.
6. Draw contour map with legend describing a section of the center.
7. Explore the economic value of wild plants; their use as medicines, foods, and dyes.
8. Explore the history of names given to animals. Example: ovenbird - named for the shape of its nest.
9. Research and report on why Fort Collins was first settled.
10. Research the origin and termination of old Fort Collins.
11. Write a report on Theodore Roosevelt's visits to the Poudre Valley.
12. Investigate the uses and abuses of public lands.

## II. LANGUAGE ARTS

1. Expand vocabulary of words related to environment and conservation.
2. Write a theme describing an environmental experience, i.e., the beauty of the outdoors, the abuse of nature by man, etc.
3. Write Hai-Ku poetry expressing an experience in nature.
4. Have a listening experience by identifying and describing the sounds in the woods, i.e., bird calls, wind.
5. Write news articles for the school newspaper on pollution in the community.
6. Creative writing experiences could be centered around a written description of the region in another 25 years of abuse of nature.
7. Practice taking field notes of important information discovered outdoors.
8. Describe folk superstitions and sayings about the out-of-doors.
9. Choose something that appears at first to be ugly. Describe the object after looking at it carefully.
10. Write a short play or pantomime centered around life if pollution problems continue to grow unabated.

## IV. ART

1. Make pencil or charcoal sketches of plants and animals at the center.
2. Make arrangements of dried grasses and other plants for decorative bouquets.
3. Take photographs in the out-of-doors with special emphasis on color and black and white highlights.
4. Make a collage of pebbles, seeds, or other plants, placing them on a slab of wood.

## V. MUSIC

1. Compose songs or ballads based on outdoor experiences.
2. Sing nature songs en route to the nature center and upon returning.
3. Observe natural rhythms and sounds in nature.

## VI. HEALTH AND SAFETY

1. Learn to identify edible and poisonous plants.
2. Be able to identify poison oak and poison ivy.
3. Practice common first aid training.
4. Know the safety rules to follow when participating in a hike.

## GENERAL REFERENCES

### Magazines, Periodicals, Newsletters

National Wildlife
National Wildlife Federation
1412 - 16th Street, N. W.
Washington, D. C.

Ranger Rick
National Wildlife Federation
1412 - 16th Street, N. W.
Washington, D. C.

Curious Naturalist
Massachusetts Audubon Society
Lincoln
Massachusetts 01773

Journal of Outdoor Education
Editor: George Donaldson
Box 299
Oregon, Illinois 61061

Environmental Education
Editor: Clay Schoenfield
Box 1605
Madison, Wisconsin 53701

Environmental Education Bulletin
National Park Service
Western Region
450 Golden Gate Avenue
San Francisco, California

The C. F. Letter
The Conservation Foundation
1250 Connecticut Avenue, N. W.
Washington, D. C. 20036

Conservation Vistas
U. S. Forest Service
P. O. Box 3613
Portland, Oregon

Environment Magazine
438 North Skinner
St. Louis
Missouri 63130

The Outdoor Teacher
Southern Illinois University
606½ South Marion
Carbondale, Illinois 62901

Conservation News
National Wildlife Federation
1412 - 16th Street, N. W.
Washington, D. C. 20036

Conservation Education Newsletter
Editor: Edward Dolder
The Resources Agency
1416 Ninth Street
Sacramento, California

FILMED FROM BEST AVAILABLE COPY

## GENERAL REFERENCES

### Free or Inexpensive Materials

National Audubon Society
Nature Center Division
1130 Fifth Avenue
New York, New York 10028

National Wildlife Federation
1412 Sixteenth Street, N. W.
Washington, D. C. 20036

Superintendent of Documents
Government Printing Office
Washington, D. C. 20402

Conservation Foundation
1250 Connecticut Avenue, N. W.
Washington, D. C. 20036

Forest Service
U. S. Department of Agriculture
Washington, D. C. 20250

Fish and Wildlife Service
U. S. Department of Interior
Washington, D. C. 20240

Project Man's Environment
National Education Association
1201 - 16th Street, N. W.
Washington, D. C. 20036

The Wilderness Society
729 - 15th Street, N. W.
Washington, D. C.

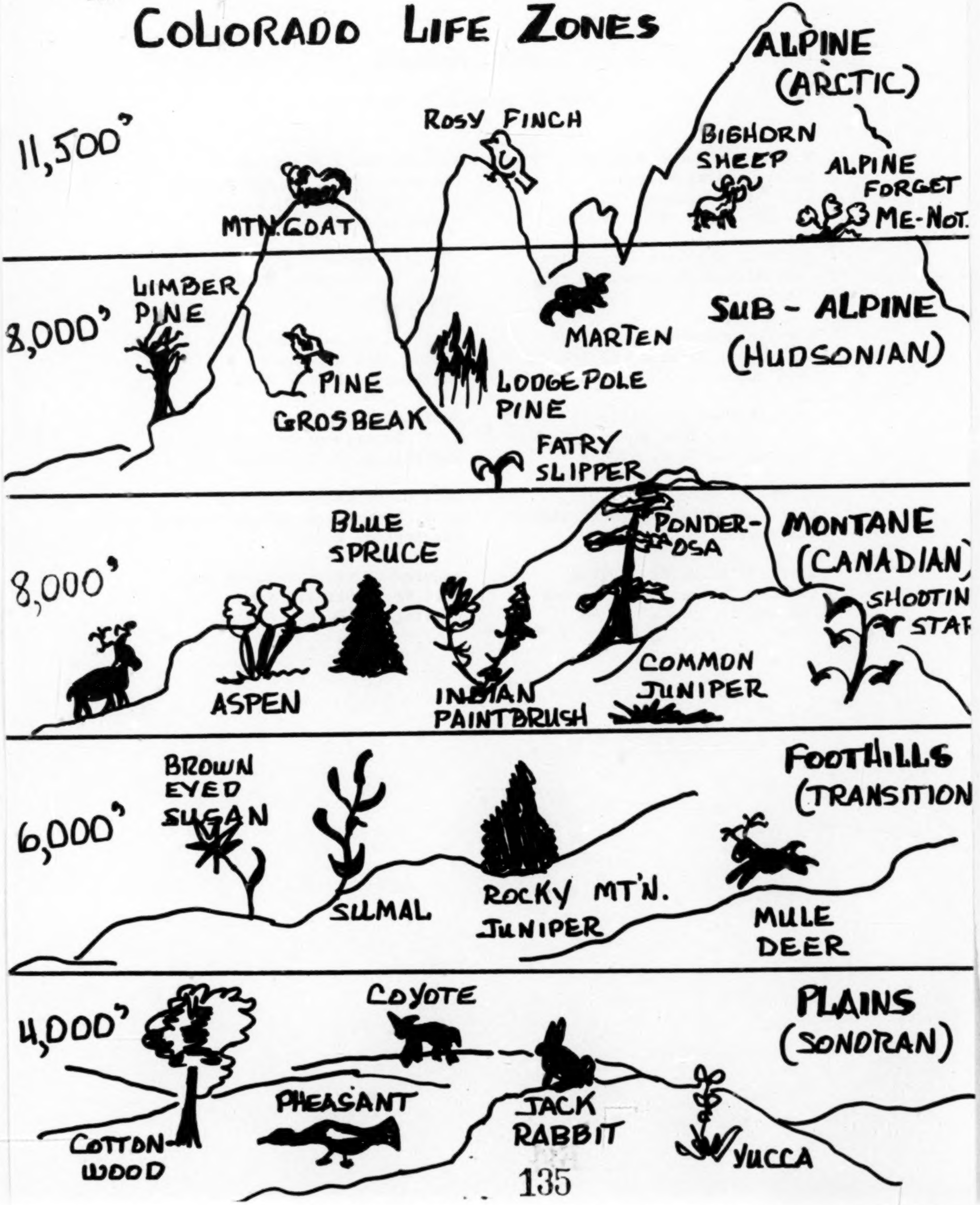
National Parks Association
1701 - 18th Street, N. W.
Washington, D. C. 20037

National Parks Service
U. S. Department of Interior
Washington, D. C. 20240

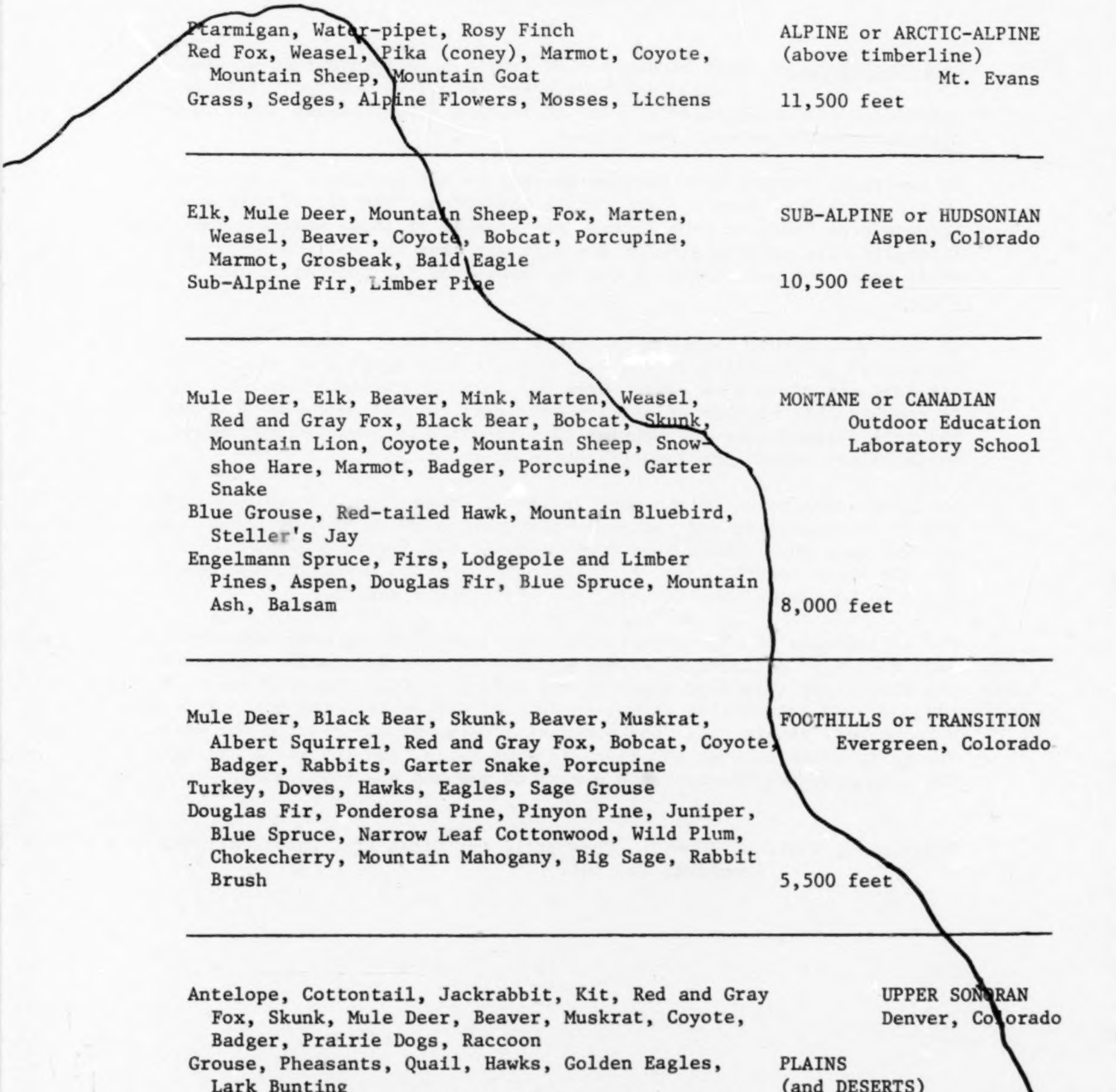
Soil Conservation Service
U. S. Department of Agriculture
Washington, D. C.

American Forest Products Inc.
1816 North Street, N. W.
Washington, D. C. 20036

# COLORADO LIFE ZONES


ALPINE
(ARCTIC)
11,500'
ROSY FINCH
BIGHORN SHEEP
ALPINE FORGET ME-NOT.
MTN. GOAT
LIMBER PINE
8,000'
MARTEN
SUB - ALPINE
(HUDSONIAN)
PINE GROSBEAK
LODGEPOLE PINE
FATRY SLIPPER
BLUE SPRUCE
PONDEROSA
MONTANE
(CANADIAN
8,000'
SHOOTIN STAR
ASPEN
INDIAN PAINTBRUSH
COMMON JUNIPER
FOOTHILLS
(TRANSITION
BROWN EYED SUSAN
6,000'
SUMAL
ROCKY MT'N. JUNIPER
MULE DEER
COYOTE
PLAINS
(SONORAN)
4,000'
PHEASANT
JACK RABBIT
COTTONWOOD
YUCCA

## COLORADO LIFE ZONES



| | |
|---|---|
| Ptarmigan, Water-pipet, Rosy Finch<br>Red Fox, Weasel, Pika (coney), Marmot, Coyote, Mountain Sheep, Mountain Goat<br>Grass, Sedges, Alpine Flowers, Mosses, Lichens | ALPINE or ARCTIC-ALPINE<br>(above timberline)<br>Mt. Evans<br>11,500 feet |
| Elk, Mule Deer, Mountain Sheep, Fox, Marten, Weasel, Beaver, Coyote, Bobcat, Porcupine, Marmot, Grosbeak, Bald Eagle<br>Sub-Alpine Fir, Limber Pine | SUB-ALPINE or HUDSONIAN<br>Aspen, Colorado<br>10,500 feet |
| Mule Deer, Elk, Beaver, Mink, Marten, Weasel, Red and Gray Fox, Black Bear, Bobcat, Skunk, Mountain Lion, Coyote, Mountain Sheep, Snowshoe Hare, Marmot, Badger, Porcupine, Garter Snake<br>Blue Grouse, Red-tailed Hawk, Mountain Bluebird, Steller's Jay<br>Engelmann Spruce, Firs, Lodgepole and Limber Pines, Aspen, Douglas Fir, Blue Spruce, Mountain Ash, Balsam | MONTANE or CANADIAN<br>Outdoor Education Laboratory School<br>8,000 feet |
| Mule Deer, Black Bear, Skunk, Beaver, Muskrat, Albert Squirrel, Red and Gray Fox, Bobcat, Coyote, Badger, Rabbits, Garter Snake, Porcupine<br>Turkey, Doves, Hawks, Eagles, Sage Grouse<br>Douglas Fir, Ponderosa Pine, Pinyon Pine, Juniper, Blue Spruce, Narrow Leaf Cottonwood, Wild Plum, Chokecherry, Mountain Mahogany, Big Sage, Rabbit Brush | FOOTHILLS or TRANSITION<br>Evergreen, Colorado<br>5,500 feet |
| Antelope, Cottontail, Jackrabbit, Kit, Red and Gray Fox, Skunk, Mule Deer, Beaver, Muskrat, Coyote, Badger, Prairie Dogs, Raccoon<br>Grouse, Pheasants, Quail, Hawks, Golden Eagles, Lark Bunting<br>Prairie Short-grass, Yucca, Broad-Leaf Cottonwood, Ash, Elm, Plum, Boxelder, Sycamore, Hackberry, Cactus Mesquite, Prickly Pear, Poppy | UPPER SONORAN<br>Denver, Colorado<br>PLAINS<br>(and DESERTS)<br>LOWER SONORAN<br>3,000 feet |

# TEMPERATURE INVERSIONS

Note to Teachers: Most students will find a keen interest in an atmospheric condition which they have observed or experienced. A classroom activity with chalkboard illustrations and follow-up discussion would be most appropriate.

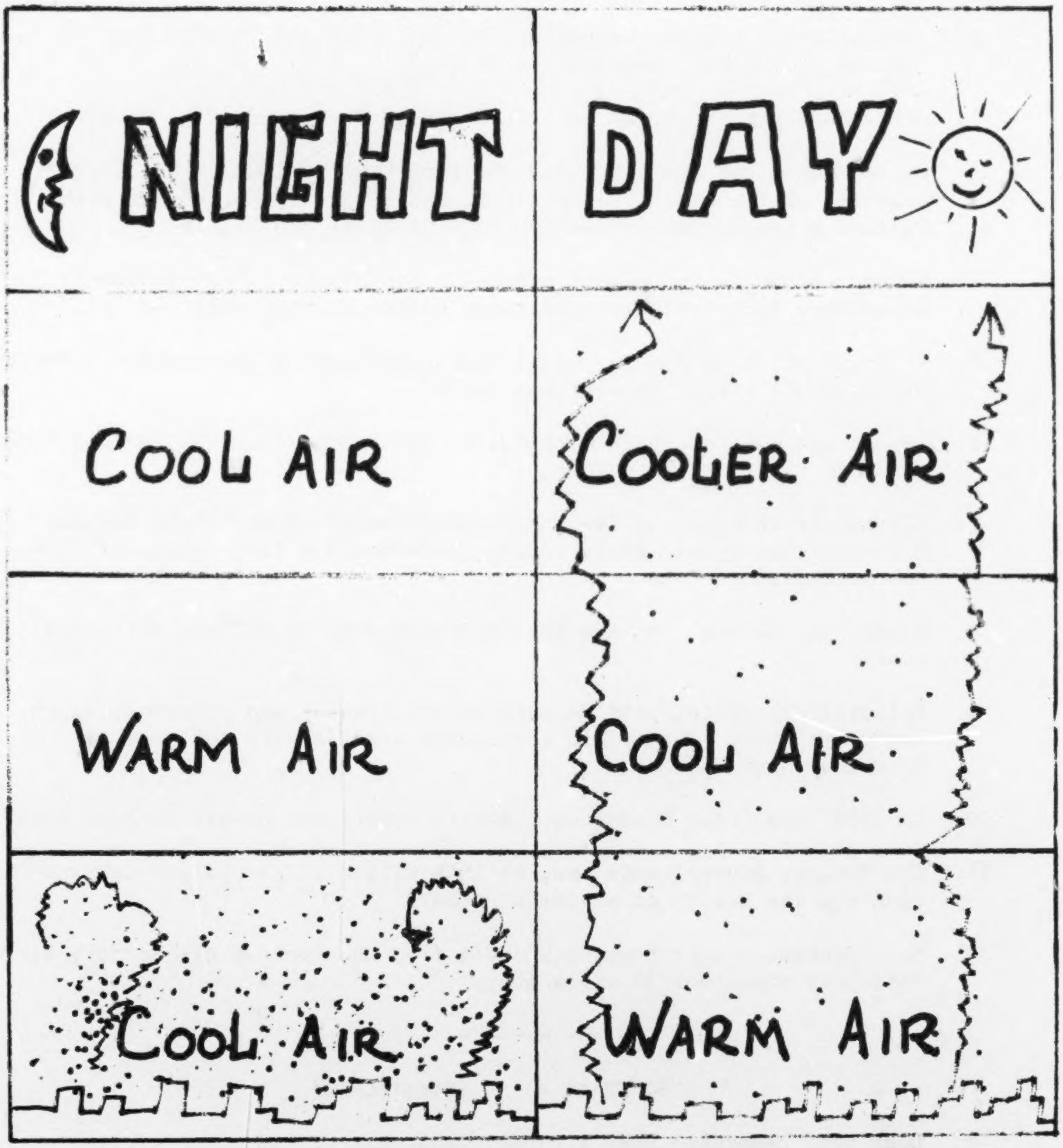
An important concept that relates weather to air pollution is an atmospheric condition known as temperature inversion. The air in many cities becomes breathable or foul largely as a result of these weather conditions. Typically, the natural life of the warm air near the earth rises or the winds carry the pollutants in the air away from the population [illegible]tions.

On occasion, normal temperature levels are reversed. Such a reversal results in an inversion in which a warm air mass moves over the cooler air near the earth's surface. Warm air from the ground rises only until it reaches this blanket of still warmer air; here it stops as if a lid had been clamped over it. During this condition the pollutants from automobiles, homes, and industry build up steadily.

An interesting point to remember is that a temperature inversion happens almost every evening and continues through the early morning hours. As the sun goes down, the ground cools quickly, as does the air above it. The air above remains warm, creating a temperature inversion and causing a lid to be placed over the air near the earth's surface.

The seriousness of this condition in the atmosphere is compounded by the fact that most pollutants are thrown into the air during the early morning hours. At this time power plants spring to full capacity and highways clogged with automobiles thrust their fuel wastes into the air. This inversion will remain until the sun's rays warm the air next to the earth enough to break through the lid. In some cases, the inversion can last for days, causing considerable damage to man and his environment.

Reference: Edelson, Edward. The Battle for Clean Air, Public Affairs Pamphlet, No. 403.


NIGHT
DAY
COOL AIR
WARM AIR
COOL AIR
COOLER AIR
COOL AIR
WARM AIR

INVERSION
Ground is cooled under clear skies--air sinks.

INVERSION BROKEN
Air is warmed by ground--air rises.

## FACTS ON AIR POLLUTION

1. In the United States, we pollute the air with 140,000,000 tons of "aerial pollutants" each year.
2. Over 390,000 tons of wastes are poured into the air every 24 hours.
3. Carbon monoxide, the poisonous gas from automobiles, is the largest polluter of the air. The Public Health Service reports that automobiles produce over 66 million tons of waste in the air.
4. Sulphur oxide is the second major air pollutant. These poisonous gases come from factories and power plants burning coal and oil.
5. Nitrogen oxide is a major waste caused by burning fuels which convert nitrogen and oxygen to nitrogen dioxide.
6. Hydro-carbons are unburned chemicals in combustion. Car exhaust fumes react in air to produce smog.
7. Fly-ash is the part of fuel that cannot burn. Coal is the largest producer, but refuse incineration contributes a large share of fly-ash production.
8. Wastes in the air cost the United States over 12 billion dollars a year.
9. Polluted air contributes to respiratory disease and premature death. Emphysema, lung cancer, and bronchitis are diseases that are, in part, caused by dirty air.
10. In 1952, the Great London Smog killed over 4,000 people in four days.
11. The Ponora, Pennsylvania smog of 1948 killed 20 people and permanently impaired the health of scores of others.
12. Near Spokane, Washington, fluorides from an aluminum ore factory killed Ponderosa pine over 50 miles away.

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## SO WHAT? - - - INVESTIGATE!

1. Does your community have air pollution control ordinances (city, state)?
2. Do industrial users of coal and oil use control devices for smoke and gases?
3. What are the local regulations on trash disposal methods?
4. What are the air pollution agencies in your community?

5. How can the operator of an automobile find out how he can improve the quality of the air?

Edelson, Edward. The Battle for Clean Air. Public Affairs Pamphlet #403.

# WATER POLLUTION
## TESTS FOR PHYSICAL AND CHEMICAL CONDITIONS OF WATER

Pollution of water in the streams, ponds, soil and snow is an increasingly important and difficult problem. Pollution may be defined as making a substance unclean or impure. Pollution is usually considered to be a change in the environment that makes an unhealthy situation for organisms native to the environment. Pollution of water, for instance, may make a better environment for some organisms such as certain bacteria, but that same "pollution" may make that environment unfit for organisms normally needing and using that water.

Standards have been set up for "clean" and polluted water. Water in ponds and streams may be tested to compare with these standards.

1. TEMPERATURE

Organisms ordinarily live within a rather limited temperature range. "Thermal pollution" may be considered to be a change from the usual water temperatures caused by industrial or natural additives to the water, such as hot industrial wastes, new hot water springs, volcanic action, etc. In the ocean, normally warm waters may be cooled too much by shifts in ocean currents or may be warmed too much.

Field directions to determine water temperatures: Take water temperatures at different depths, using a F° or C° thermometer as directed by instructor.

2. TURBIDITY

A Secchi Disc is used to measure turbidity by lowering by a cord from the shaded side of the boat or from a stream bank. When the white quadrants disappear, note the depth. Lower the disc farther and then raise it until the white appears. Note the depth and average it with the first reading. This represents depth of light penetration.

To construct a Secchi Disc: Cut a circular disc 20 cm. in diameter from a tin can or sheet metal. Put an eye bolt through the center and a weight underneath. Paint it with alternate quadrants of black and white. Connect a cord to the eye bolt in the center of the disc.

3. CHEMICAL TESTS

(Cooperation of chemistry and biology departments is desirable.) When making the chemical tests of water of a pond or stream, the class may be divided into working groups with one test assigned to each group. Each group would need to take one or more water samples.

Directions for Water Samplers:

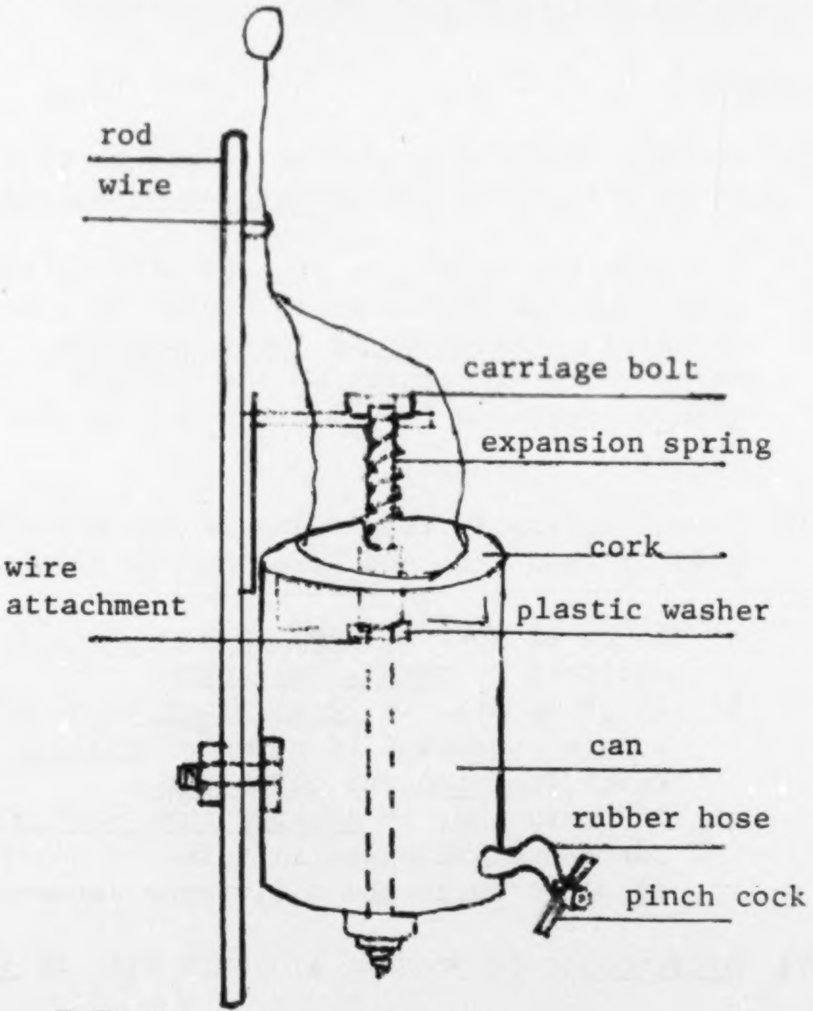
1. The simplest water sampler is a bottle (100-250 ml.) with ground

glass stopper. When taking sample, fill bottle to overflowing and stopper.

2. Water sampler that may be used in deep, as well as shallow, water.

The gadgeteer of the class may want to earn some extra credit by constructing this water sampler.

Tin can attached to an aluminum (or other) rod. Large cork held in place by expansion spring. Cork and spring secured by a long bolt. After the can is immersed to the desired depth, the spring is released by pulling the wire attached to the cork. Can fills and spring forces the cork into place again. Marks are placed on the holding rod to indicate various depths. A piece of metal tube can be inserted into the can near the base; a piece of rubber hose and clamp make a handy dispenser for water for tests.



a. pH Test

Place about 25 ml. test water in a beaker. Using the LaMotte Soil Test Kit reagents, place a drop of the test water in the basin of the china test plate. Add a drop of the bromthymol blue indicator and determine pH by comparing with color indicator chart of the kit.

b. Alkalinity

Measure 50 ml. of the water sample into a beaker. Add 5 drops of phenolphthalein indicator (0.5 g. phenolphthalein in 100 ml. of 95% alcohol ethyl). If the water turns pink, add N/10 sulfuric acid from a burette, drop by drop, stirring until the pink disappears. This is the end point. Note the burette reading. The number of ml. used times 100 gives the P or phenolphthalein (ph-th) alkalinity ($CaCO_3$) in ppm (parts per million).

To the same sample, add 2-6 drops methyl orange indicator. If the sample turns orange (salmon color), record as 0.0.M.O. (methyl orange). If the sample remains yellow, titrate with .02 N $H_2SO_4$ until it turns orange. Record the amount of acid used in the MO titration, including the amount used, if any, in the ph-th (phenolphthalein) titration.

Results:

1) 10 times the ml. acid used in the ph-th titration equals ph-th alkalinity ppm as calcium carbonate.

2) 10 times the total ml. of acid used in the ph-th titration plus the MO titration equals MO alkalinity in ppm as calcium carbonate or total hardness. Most water values will be between 45 and 200 ppm. Soft waters (less than 15 ppm) are less biologically productive than harder waters.

3) Normal carbonate is present if the alkalinity to ph-th is greater than zero and less than MO alkalinity.

    a) If ph-th alk. is exactly ½ of MO alk., it is due entirely to normal carbonate.
    b) If ph-th alk. is less than ½ of MO alk., normal carbonate expressed in terms of calcium carbonate is equal to twice the ph-th alk.
    c) If ph-th alk. is greater than ½ of MO alk., normal carbonate expressed in terms of calcium carbonate is equal to twice the difference between them.

4) Bicarbonate is present if ph-th alk. is less than ½ MO alk.

5) Bound carbon dioxide is the sum of the $CO_2$ as carbonate and ½ that as bicarbonate.

c. Free Carbon Dioxide ($CO_2$)

Draw 100 ml. of water sample into a beaker. Add 5 drops of phenolphthalein indicator. Titrate with N/44 NaOH until it turns pink. The amount of NaOH in ml. times 10 gives the concentration of $CO_2$ in ppm. $CO_2$ concentrations above 22 ppm will greatly curtail aquatic animal life.

d. Dissolved Oxygen (DO) - Winkler Method

Take sample in glass-stoppered 250 ml. bottle, using care not to include air bubbles. Keep bottle full and tightly stoppered.

1) Add 1 ml. manganous sulphate solution. Stopper bottle and mix several times. Manganous sulfate solution ($MnSO_4:H_2O$): 364 g. in 1 liter distilled water. Use separate pipettes for all reagents.

2) Add 1 ml. alkaline-iodide solution. Add reagent well below surface of the liquid to avoid loss of the precipitate when restoppering bottle. Shake well and allow the precipitate to settle (wait 5 minutes). Alkaline-iodide reagent: 700 g. KOH and 150 g. KI in 1 liter distilled water.

3) Add 1 ml. concentrated sulfuric acid by allowing it to run down the neck of the bottle. Shake the sample as soon as possible after adding acid.

4) Pour sample into a beaker or flask and titrate with sodium thiosulfate N/40 until a light amber color. N/40 sodium thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$): 6 g. in 1 liter distilled water. Solution may be preserved by adding 0.4 g. NaOH.

5) Add 1 ml. starch solution and titrate to water whiteness. Starch solution: 1% sol. of soluble starch in a 20% sol. of NaCl. Bring the sol. to a boil before adding starch.

6) Calculate ppm dissolved oxygen as follows:

   a) If the full 250 ml. of sample was used:
      ppm dissolved $O_2$ = ml. sodium thiosulfate used in titration times 0.8
   b) If 200 ml. sample was used, the reading is direct. The amount of thiosulfate used in ml. equals the ppm dissolved oxygen.
   c) For other volumes of sample titrated, use the formula:
      ppm dissolved $O_2 = \frac{(200 \text{ x ml. thiosulfate})}{\text{ML. OF SAMPLE TITRATED}}$

Because oxygen may be lost due to an increase in temperature and or microbiological respiration, the DO should be done within one hour after the sample is collected. If this is not possible, add the manganous sulfate and the alkaline-iodide solutions to the water samples in the manner described below. Once treated, the samples may be set aside and analyzed at a later date.

Postponed analysis: To each sample add 2 ml. manganous sulfate solution, followed by 2 ml. alkaline-iodide, well below the surface of the liquid. Replace the stopper and mix by inverting the bottle several times.

Possible Investigations:

1) Are there major differences in the DO level of local lakes, ponds, streams, rivers?

2) Does the DO differ from depth to depth, season to season?

3) Are there noticeable relationships between animals and plants and the amount of DO in the water?

e. Iron in Water

May occur in acid water as $Fe(HCO_3)_2$ ferrous hydrocarbonate.

1) Place water sample in a glass cylinder 30 cm. high by 2-25 cm. diameter with a flat bottom. Add 1 ml. 10% aquaous sodium sulfide ($Na_2S.9H_2O$). Look through the water column at a white substratum. Within a few minutes a yellow-green to brownish-black color appears.

2) To determine ferrous or ferric form:

   a) Add $HNO_3$ or strong ammonia: ppt.-ferrous.

   b) Ferric-acidify water with small amount iron-free HCl. Add a few drops 10% potassium thiocyanate sol. Reddish ppt. indicates ferric iron.

   Iron is not as injurious to fish as the acid water it is usually in.

FILMS AVAILABLE

From Colorado Department of Health
Colorado Water Pollution Control Commission
4210 East 11th Avenue
Denver, Colorado 80220

1. Ill Wind, Ill Water. 25 minutes. B&W. USPHS 1962. Shows the kinds and sources of air pollution and the harmful effects on human, plant, and animal life. Also discusses water pollution and treatment methods. High school and adult.
2. The River Must Live. 24 minutes. Color. Shell Oil Company 1968. Filmed in Germany. Explains water pollution problems in layman's language. Clear and easy to understand narration and outstanding photography. Junior high and above.

Other films available as listed in pamphlet available from the Colorado Department of Health.

From Film Library - Larimer Public Schools and CSU

3. House of Man - Our Changing Environment. 17 minutes. Color. EBE (i-j-s-a). Reveals the waste of resources in cities, woodlands, farmlands, and the pollution of river and of air. Comparison is made between the progress through wasteful methods and through the intelligent preservation of resources.

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Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

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Morholt, Brandwein Joseph. A Source Book for Biological Science, 2nd Ed. Harcourt, Brace and World, Inc.

Parke, Prof. Robert V. Department of Botany and Plant Pathology, Colorado State University.

Thomas, Prof. Bert. Zoology Department, Colorado State College.

## LABORATORY DIRECTIONS

Morrill, Catherine C. Fort Collins High School.

## CLEAN PLANTS???

Detergents are commonly found in our water sources;
BUT
what happens to plants grown in deterginated water?

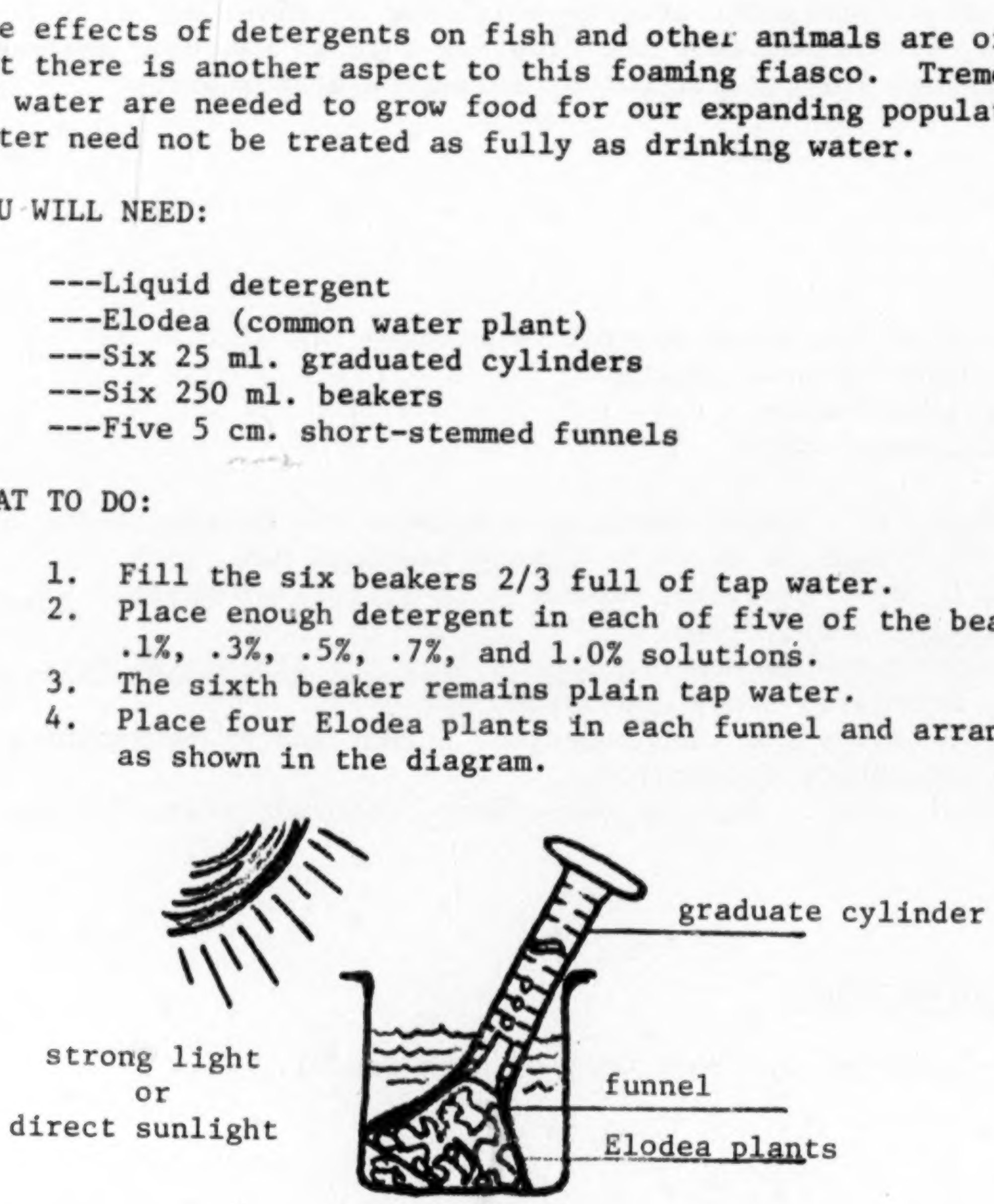
The effects of detergents on fish and other animals are often mentioned. But there is another aspect to this foaming fiasco. Tremendous amounts of water are needed to grow food for our expanding population. This water need not be treated as fully as drinking water.

YOU WILL NEED:

---Liquid detergent
---Elodea (common water plant)
---Six 25 ml. graduated cylinders
---Six 250 ml. beakers
---Five 5 cm. short-stemmed funnels

WHAT TO DO:

1. Fill the six beakers 2/3 full of tap water.
2. Place enough detergent in each of five of the beakers to make .1%, .3%, .5%, .7%, and 1.0% solutions.
3. The sixth beaker remains plain tap water.
4. Place four Elodea plants in each funnel and arrange the materials as shown in the diagram.



5. Measure the amount of oxygen produced in the six graduates every other day for one week. Be sure to add enough water to each beaker to maintain the original level.
6. Also, observe the condition of each group of Elodea plants.

While waiting, why not try another experience?

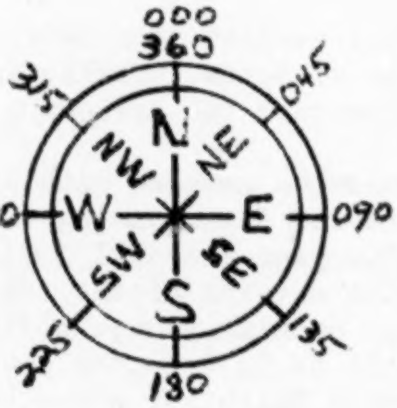
QUESTIONS:

What is the relationship between the concentration of the detergent and the amount of oxygen produced? Can you show this relationship with a graph? Does the physical condition of the plant relate to the graph?

## THE COMPASS

The study of the compass is very important for anyone who is going to do any hiking through forests, over mountains, or across desert lands.

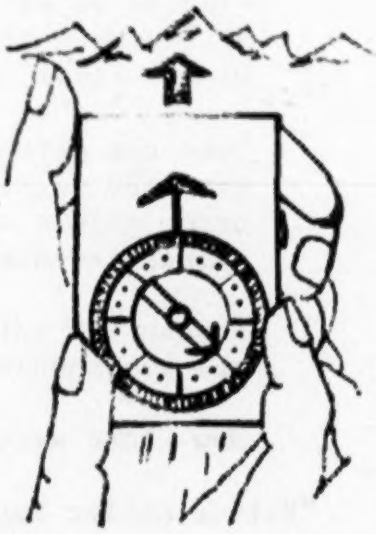
The cardinal directional points of the compass are North, East, South, and West. The in-between points are North-east, South-east, South-west, and North-west. The compass is marked with the 360 degrees of a circle. These degrees are used to find directions. Since there are 360 degrees, East becomes 90 degrees, South becomes 180 degrees, and West becomes 270 degrees.



There are three main purposes for using the compass without the additional help of a map.

1. Finding directions or obtaining one's bearing:

   Let us assume that you are standing on an open spot and want to know the directions or "bearings" to a distant hilltop or protruding rock. You face squarely the direction you want to determine, and hold your compass steady in front of you in one hand. Aim the direction arrow at the landmark. With the other hand, twist the case until its North marker lies under the needle North. Read the degrees at the arrow or direction line. You now have the direction toward the landmark.



2. Following a direction with the compass:

   If you want to explore a distant hilltop which can be seen from the location where you are standing, and if you decide to reach it by traveling cross-country through the trees and over the hills, determine the bearing of your destination as described above. If your azimuth or "the way" is 140 degrees, it is best to jot that number down to remember it correctly.

   Start walking toward your destination. At first it is easy because it is right in front of you. Soon it will be hidden from view because of trees or land formations between you and your desired destination. The direction in which you have to travel by compass is 140 degrees. Hold the compass in the palm of your hand with the compass housing turned in such a way that the needle rests on the North line. Follow the arrow at 140 degrees. It is wise to notice a prominent landmark in that direction and walk to it. When you reach the landmark, pick out another one and continue to do this until you reach your desired destination.

"Boxing or Squaring your Compass"

Find a relatively level spot with a little or no underbrush so that the students, working individually or in groups, can move with ease. Give them the following instructions.

Hold the compass with both hands at waist height. Align the compass needle, dial housing and direction of travel arrow with magnetic north. (The base and dial indicator are swiveled so that they can be turned with a twist of the hand.) Turn your body to face North. Pick out any prominent object directly North as indicated by your compass. (It will be in front of you since you are also facing North.) Walk 50 paces North (or any other appropriate measure), keeping your eyes on the sighted object. Stop.

Turn the direction of travel arrow indicator until the arrow is lined with 90 degrees on the dial housing. Site any new object to which the direction of travel arrow points and, keeping your eyes on the sighted object, walk 50 paces in its direction. Your compass needle will remain oriented with North as you travel in this easterly direction. Stop.

Turn the direction of travel arrow indicator until the arrow is lined with 180 degrees. Site any new object to which the direction of travel arrow points and walk 50 paces in its direction. As above, your compass needle should remain oriented with North. Stop.

Repeat the activity with the direction arrow pointing to 270 degrees, and you should return to your exact starting point.

How close were you? Can you account for any errors? (See diagram.)

"Silver Dollar Hunt"

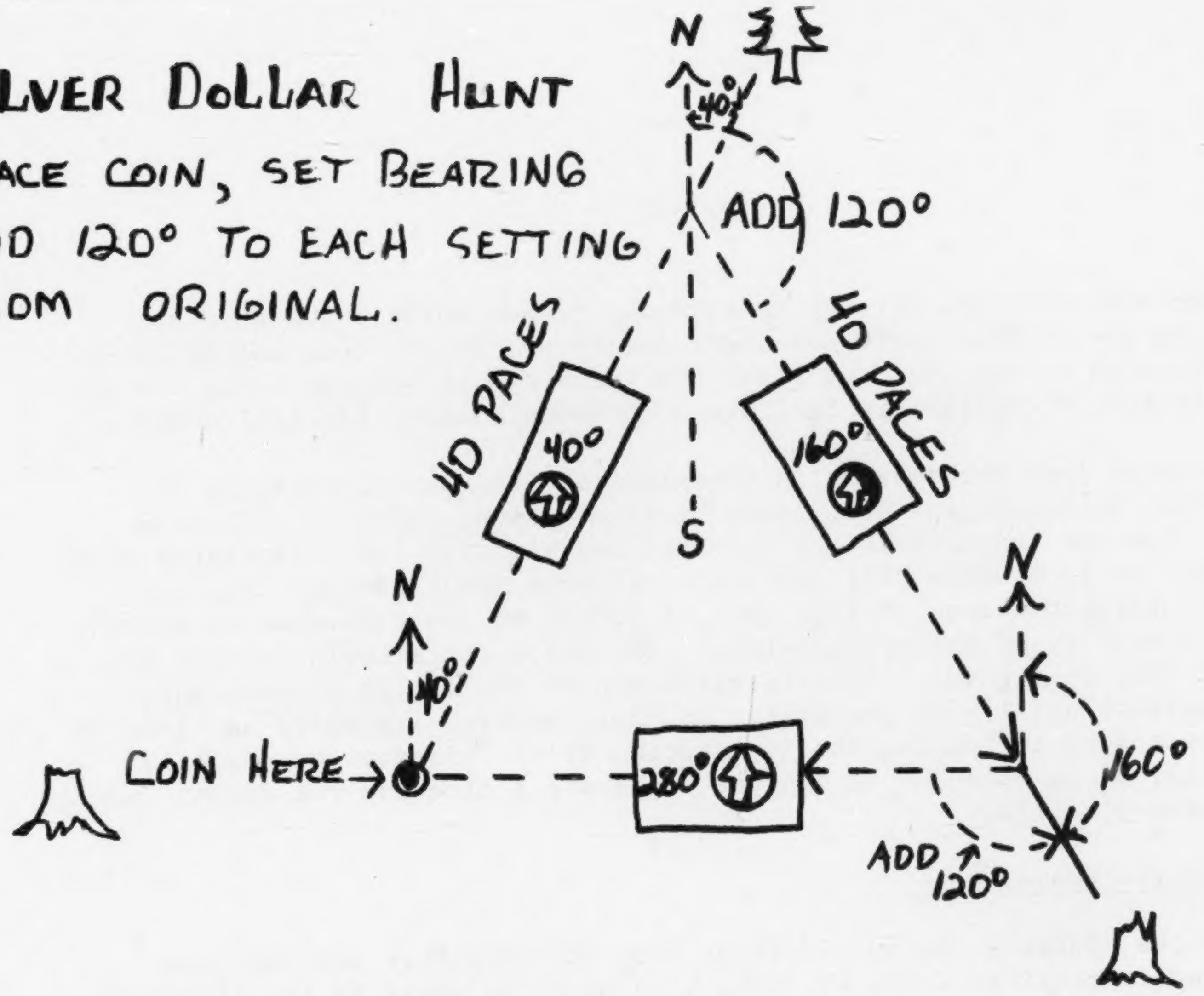
Make up a number of fake silver dollars and have each participant place one at his feet. Make up a number of cardboard instructions with distances and directions as follows:

1) Go 40 steps 90 degrees; then 40 steps 210 degrees; then 40 steps 330 degrees.
2) Go 50 steps 0 degrees; 50 steps 120 degrees; 50 steps 270 degrees.
3) Go 100 steps 18 degrees; 100 steps 138 degrees; 100 steps 258 degrees.

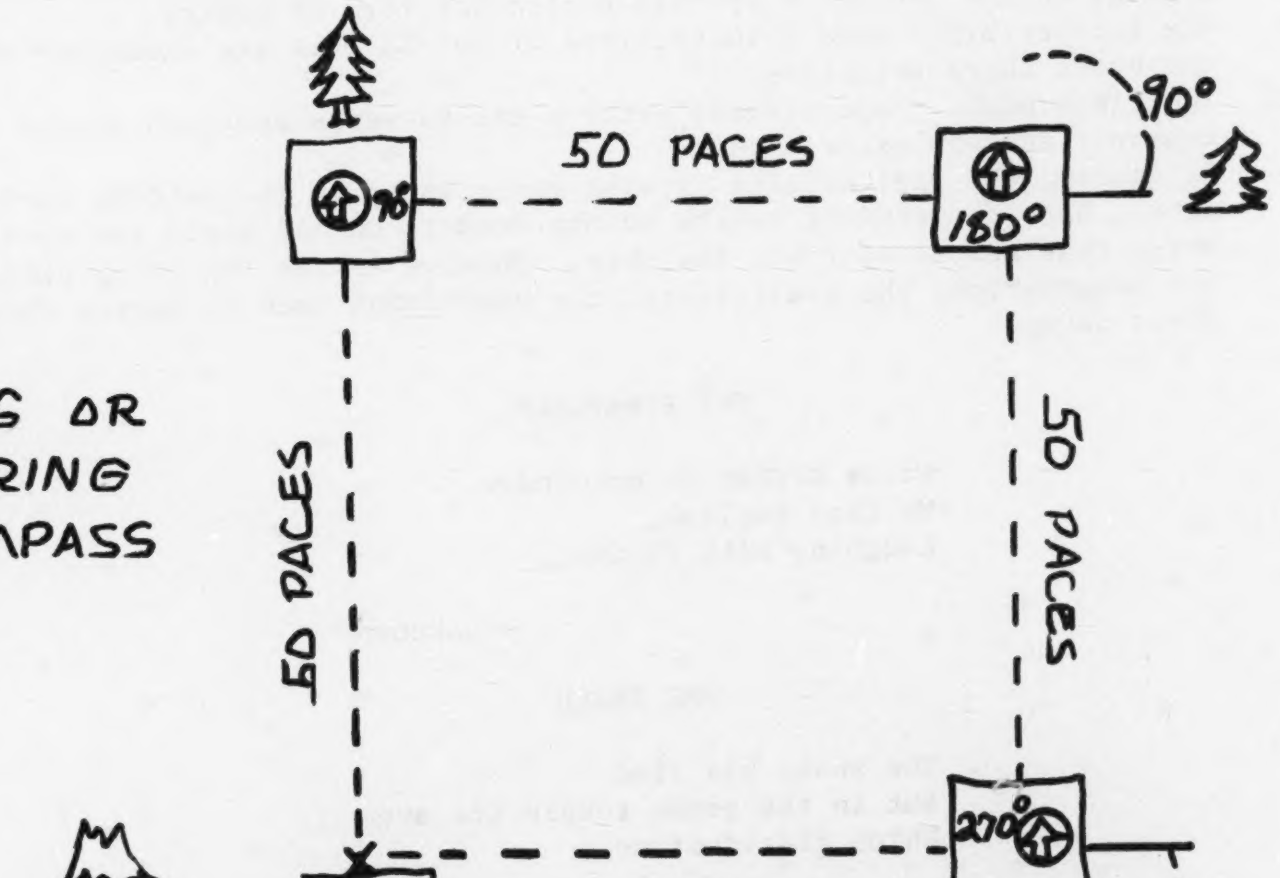
The student who arrives closest to his silver dollar is the winner. (See diagram.)

# SILVER DOLLAR HUNT

PLACE COIN, SET BEARING
ADD 120° TO EACH SETTING
FROM ORIGINAL.


N
40°
ADD 120°
40 PACES
40°
40 PACES
160°
S
N
140°
COIN HERE →
280°
N
160°
ADD 120°

# BOXING OR SQUARING A COMPASS


90°
50 PACES
90°
180°
50 PACES
50 PACES
270°
START
380°
50 PACES
90°

## HAI-KU

Why not have students develop sensitivity to the world about them by creating poetry that expresses their feelings. An art form called Hai-Ku was invented by the Japanese about 700 years ago to provide a way for man to effectively express his feelings and thoughts about his environment.

In Japanese (not necessarily in translation), the Hai-Ku consists of seventeen syllables in three lines of five, seven, and five syllables each. The two characteristics--brevity and rigidity--are associated with Hai-Ku. In fact, some call the art a telegram about nature. Two additional characteristics of this type of poetry is its reference to seasons and its quality of being suggestive. The above characteristics are mentioned only as a guide. The effectiveness of the medium depends upon the creative ability of the writer to truly observe the world he lives in and his talent in rousing the imagination of the listener or reader. Actually, it is intended to capture and share a fleeting yet dynamic moment in a person's life.

Getting the Class Ready:

1. If the students are not familiar with the structure and the basic characteristics of Hai-Ku, some time might be spent in the classroom working on the mechanics of this particular form of poetry.
2. The teacher might read illustrations of Hai-Ku that are exemplary of the basic characteristics.
3. The class might cooperatively write a Hai-Ku verse centered around a common classroom experience.
4. Of course, the real writing is best experienced in the outdoor environment. Here the student reacts to the wonders of his world and creates words that reconstruct his thoughts. Observe in the following verses the imagination, the sensitivity, the expression used to convey thoughts about nature.

### THE FIREPLACE

Winds scream at my window.
My fire replies,
Laughing with flames.

--Unknown

### THE SNAKE

The snake has fled
But in the grass remain its eyes
Which glared at me.

--Kyoshi

### AFTER THE STORM

The thunder storm goes by;
On one tree evening sunlight.
A cicada cry.

--Shiki

### AUTUMN NIGHT

That there is only one
Is unbelievable tonight.
This harvest moon!

--Ryota

Decidious trees
As in the lives of people
Green come and go.

--6th Grader

### OLD POND

Old Pond
Frog jumped in
Water sound.

--Basho

Follow-Up:

1. Ditto and distribute anthologies of Hai-Ku verse prepared by the students. Have the anthology illustrated by drawing from nature that describes the verses.
2. Prepare a tape recording of students orally presenting their favorite Hai-Ku.

References:

Anderson, Harold H. Introduction to Hai-Ku.
"Hai-Ku," Literary Cavalcade, January, 1968.

## VERSE POWER

The earth has its music for those who will listen,
Its bright variations forever abound.
With all the wonders that God has bequeathed us,
There's nothing that thrills like the magic of sound.

--Reginal Holmes

## TO LOOK AT ANY THING

To look at any thing,
If you would know that thing,
You must look at it long:
To look at this green and say
'I have seen spring in these
Woods,' will not do--you must
Be the thing you see:
You must be the dark snakes of
Stems and ferny plumes of leaves,
You must enter in
To the small silences between
The leaves,
You must take your time
And touch the very peace
They issue from.

--John Moffitt

## THE WIND

Quieting down
Almost to a breeze
The wind whispers gossip
Among the trees
And then in a rush
To tumble and frisk
With waves in the bay
Wind can batter and pound
With savage might
And go roaring in fury
Through the night.
And I never hear one sound
It makes, passing
But I wonder what sorrow
Can cause winds to sigh . . .
Yet in the next moment
It whistles away
To sweep clouds from the sky
For a fair dawning day.

--Mary R. Hurley

## "I DON'T KNOW WHAT GOT INTO ME"

"I don't know what got into me
I sprayed a fly with DDT
It fell, and there beside the road
'Twas gobbled by a tiny toad
A hognose snake came flowing by
and ate the toad; and, from the sky
A hawk swooped down and snatched the snake
But dropped it, writhing, on the lake
Where, naturally, a pickerel lay
To put the writhing snake away
I caught the pickerel in the pond
A fish of which I'm very fond
And baked it, as I now recall,
And ate it, DDT and all.
I don't know what got into me
Except some more damn DDT."

--Author Unknown

The voice that beautifies
the soil
The voice on high
The voice of the rolling
thunder
Above the darkening clouds
Again and again its heard.
The voice that beautifies
the soil.

--Navajo Chant

## OUTDOOR EDUCATION CLICHES

-- An English Class Might Want to Have Fun With Our Language!

The following words and phrases have their origin in the outdoors. The literal translation differs considerably from commonly accepted meanings today. Students might want to discover additional phrases that illustrate this strange language of ours. Meanings might be developed for the following-listed words and phrases.

Stick in the mud.
Out on a limb.
Hawk-dove
Can't see the forest for the trees.
An old mossback.
Swamped.
Scrubby.
Owly.
In the sticks.
Up the creek without a paddle.
Up the river.
The bogey-man will get you.

# MUSIC AND OUTDOOR EDUCATION

The creative teacher can plan and implement many experiences for students in discovering sounds and developing appreciation for music in context with the outdoor education program. Songs about the beauty of our world abound, and these can be used by the classroom teacher in developing esthetic values.

Students could participate in group singing activities while on the bus en route to the nature center. Singing on portions of trail walks or at rest stops might be equally appropriate. The attitude of students toward music and toward appreciation of the environment can be enhanced by effective planning by the classroom teacher. Taped songs can be used in case the teacher might feel the need for a little help in terms of music expertise. The following pages suggest songs that might be used to involve the class in a song-fest.